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Immigration for the calendar years 1890 and 1891, and the last month thereof, has been as follows:

	1890.	1891.
Month of December	22,717	28,593
Year	491,036	560,666

The British immigration was within 155 of the same in both years, 120,722 last year. Polish, Russian, German and Swedish immigration has largely increased. The total is in reality the largest on record, with the single exception of the year 1882, when 788,992 were reported, or deducting 98,295 Canadian immigrants reported in that year, 690,697. 1881 and 1883 also had larger reported totals than 1891, but deducting the Canadian immigration, no longer reported, their totals fall below 1891. About 100,000 per year of Canadian immigrants used to be reported, but on representations that these statistics were inaccurate and excessive, the collection of all such statistics was abandoned in 1886.

Anchor ice at Chicago cut off the water supply of the whole city for about eight hours on Jan. 21, and of the former city of Lake View for over 24 hours on Jan. 21 and 22. The main crib is hexagonal and has inlet gates on the west, northwest and north sides. Trouble at the main crib began Tuesday and continued through the day and night and on through Tuesday night. About 2 a. m. Wednesday, the northwest gate became stopped with ice, and a little before 7 a. m. the north gate became practically closed, while the west gate admitted only about one-third of its full capacity. About the same time the Lake View and Hyde Park intakes became clogged. Hyde Park received water again about 1 p. m. and the main city about 2 p. m., Wednesday, but not before the next afternoon did Lake View receive its supply. At the main crib the fire boat "Yosemite" arrived at about 10 a. m. Wednesday, and with two lines of 3¼-in. hose cleared the gates in about three hours. At the Lake View intake last winter, perforated 1¼-in. pipes were carried around the circumference of the outer end of the intake and connected with a compressed air plant at the shore. To prevent the formation of anchor ice at these intakes compressed air was blown across the mouth of the pipe, keeping the water in constant motion. It is reported that this device was insufficient during the late trouble, but it seems that low water in the lake was the real cause, and that ice was piled up around the mouth of the intake. The above-mentioned device was described and illustrated in Engineering News of June 27, 1891.

A very uncommon type of stationary engine is in operation in New York City at the 20th St. Station of the Edison Electric Lighting Co. It is a vertical triple expansion non condensing engine, similar in its general appearance to a modern marine engine. With 125 lbs. of steam it is developing about 600 I. HP., and it is intended to use steam pressures as high as 200 lbs. Any of the three cylinders can be disconnected and the steam passed around it without preventing the running of the engine; and thus it can be operated as a triple expansion, a compound, or even as a simple engine, according to the work in hand. The valve gear is of the Joy type. The valves are positive driven and controlled by a hydraulic governor. The point of cut-off on each cylinder is controlled by a hydraulic governor, and is indicated at all times on a dial attached to each cylinder. It can be altered and adjusted without stopping the engine. All the main bearings and main guide surfaces are kept cool by water circulation, thus applying to stationary practice a safeguard against breakdowns which has become common in the best marine engines. The principal features of the design are due to Mr. John Van Vleck. The engine was built by the Dickson Mfg. Co., of Scranton, Pa., and for the design of many of the details credit is given to Mr. J. W. Sargent, Chief Draftsman of that company.

Water is to be supplied to Managua, the capital of Nicaragua, by 15 miles of 5-in. pipe made by the American Tube & Iron Co., of Middletown, Pa., and Youngstown, O. The pipe will be provided with the Matheson lock joint. Water is to be taken from the crater of an extinct volcano and have a fall of 1,200 ft. The engineer is Mr. Gus C. Henning, of New York.

A "perfect screw" has been made by Prof. H. Rowland, of the Johns Hopkins University, for his new dividing-engine. This screw is 17 ins. long, 1¼ ins. in diameter with 20 threads to the inch and is made of Jessup tool steel. It was cut in the laboratory on an ordinary lathe, and then ground with fine emery under water and oil at a fixed temperature for over three weeks. A nut ground as nearly perfect as possible was constantly moved backward and forward over its entire length, and if the threads were not exactly even they were worn down in this manner. The dividing-engine, to which this screw is applied, rules 100,000 lines to the inch on highly polished speculum metal, though it is said to be capable of ruling 1,000,000 lines in the same space. The largest grating yet made is 5 ins. in diameter and contains 110,000 lines to the inch. Six days and nights were consumed in making it. The cutting is done by a fine diamond, and the error due to the error in dividing the head of the screw is corrected by ingenious but complicated mechanical appliances designed by Prof. Rowland.

The most serious railway accident of the week was a head collision, Jan. 22, at Blue Water, N. M., on the Atlantic & Pacific R. R. An eastbound excursion train and a westbound regular passenger train came into collision, wrecking both engines and the smoking car of the regular train. There were five men killed, all of them railway employees. The accident is said to have been caused by conflicting train orders.——There was another serious railway accident of a similar character to that of the principal accidents recorded in our last two issues, being a derailment followed by the burning of the wreck. A westbound express on the Chicago, Rock Island & Pacific Ry. was derailed near Blue Island, Ill., at midnight, Jan. 22, and the cause is said to have been a broken rail. The engine remained on the track, but all the cars, comprising mail and baggage cars, 3 passenger cars and 2 sleeping cars, were derailed and ran into the ditch. A stove in the baggage car set fire to the wreck, and the cars and mails were destroyed. Several persons were injured, six of them seriously.

Two locomotive boiler explosions are reported. The first was near Birmingham, Ala., Jan. 17, the engine belonging to the Debardeleben Coal & Iron Co. It is said that the engine ran out of water, but the driver kept on in hope of reaching the next tank. The driver and fireman were killed. The second was at Philadelphia, Pa., Jan. 23; the engine belonged to the Philadelphia & Reading R. R., and was stancing at the time on a side track. Nobody was hurt.

Another crossing accident occurred at Chicago, Ill., Jan. 19, at the same crossing where the fatal accident occurred Jan. 14, and noted in our last issue. In this case a street car was crossing the tracks when a switch engine standing near was suddenly started and ran into the car, which was fortunately empty.

A serious railway accident occurred near Tiflis in Russia, on the Transcaucasus Railway, Jan. 21. It was a head collision between two trains of oil cars. The oil caught fire from the engine fireboxes and the stoves in the cabooses. It is said that six men were burned to death in the wreck and both trains were destroyed.

The Albany Capitol has already cost the tax-payers of New York $18,000,000, and a bill is now before the legislature asking for $800,000 more for continuance of work upon it. Mr. Isaac G. Perry is the architect now carrying out the original plans of the late Mr. H. H. Richardson, of Boston, Mass.

The ship canal projected to connect Lakes Samish, Washington and Union, in the vicinity of Seattle, Wash., with Puget Sound, will cost about $6,400,000, according to the report of the government engineers who have recently completed the surveys. There will probably be four sections of canal excavation, the longest of which will be that connecting Lake Samish and Lake Washington. This section will cost about $4,900,000 and will require a lock with a 10.5-ft. lift. The section connecting Lake Washington with Lake Union will be 2,600 ft. long and will require a lock 400 ft. long, 50 ft. wide, 26 ft. deep over the sill, and with a lift of 17.5 ft. The section between Lake Union and Salmon Bay will be 6,700 ft. long. From Salmon Bay to deep water on Puget Sound, two routes are under consideration; one along Salmon and Shilshole bays and the other a canal to Smith's Cove. Both will require the construction of a lock 400 ft. long, 50 ft. wide, and 16.6 ft. deep. The canal will be in all cases 80 ft. wide at the bottom, 158 ft. wide at water line, and 26 ft. deep. It is stated that the Smith's Cove route is the one preferred.

Another railway is to be built in Western Australia, contracts having been made with a colonial firm for the construction of a line south from Perth to Bunbury, about 125 miles, at a cost of $6,000 per mile. The line will follow the coast at the foot of the Darling Range, passing through a country adapted for fruit growing. It is proposed to extend the line to Vasse, to connect with an existing line, thus forming a complete west coast line from Geraldton to Albany, about 500 miles. Judging from the estimated cost per mile, track-laying is about all there is to be done.

Car lighting by the Pintsch compressed gas system has been adopted on the Belfast & Northern Counties Ry., Ireland, to replace oil, and the gas making plant is being erected.

The Watervliet arsenal shipped to San Francisco on Jan. 25 three 8-in. breech-loading steel rifles, throwing a 300-lb. projectile with 150 lbs. of powder eight miles. Twelve more of these guns are ready for shipment. The finishing touches are also being put on ten 12-in. siege guns and 45 smaller guns. The gun foundry is being worked to its utmost capacity.

The conductors and motormen of the Rochester Ry. Co. are to receive $1,000 in prizes awarded as follows: First prize of $200 to the conductor making the best record for neatness of dress, gentlemanly conduct, strict observance of rules, etc. The motormen will receive prizes of $150, $100 and $50 for the good condition of motors, freedom from burning and flat wheels, and care and judgment in emergencies.

The pig iron production in the United States for 1891 was 8,279,870 tons of 2,240 lbs., says the American Iron and Steel Association in its last report. This is a decrease of 922,833 gross tons from the production of 1890, or over 10%. This decrease was in the first half of 1891, as the production of the second half was greater than either half of 1890. The stocks of pig iron in the hands of manufacturers and unsold on Dec. 31, 1891, amounted to 608,921 gross tons. The amount for Dec. 31, 1890, was 661,821 gross tons. The production of Bessemer steel rails in 1891 was 1,218,874 gross tons, a decrease of 577,615 gross tons from the production of 1890.

Two East River bridge bills are before the New York Legislature—that of Mr. Weed appointing a commission "to locate one or more bridges," over the river, and that of Mr. McCarren again introducing the East River Bridge Co., which is backed by the Union Elevated Ry. Co. The latter company is to build two bridges; one from Broadway, in the Eastern District of Brooklyn, to a point between Delancey and Rivington Sts., in New York, and the other from about Fulton St., Brooklyn, to Jackson St. New York. The latter corporation is to have a capital of $25,000,000.

The Niagara Falls power tunnel is to be extended a distance of about 550 ft. eastward, giving it a total length of 7,250 ft. Plant is being proposed and wheel pit and tunnel built for the Soo Paper Co. with a capacity of 40 tons of raw material daily.

The improvement of state roads in New Jersey was made the subject of a special convention at the close of the agricultural convention held in Trenton on Jan. 22. Dr. James G. Mackensie said that in Pennington Township above $50,000 had been spent in 15 years practically to no purpose in repairing dirt roads. He said that a mud blockade in Iowa recently caused a loss of $1,500,000, and a million voters are disfranchised at every general election from the same cause, 20,000 farmers in New York State alone being thus prevented from reaching the polls. Dr. Mackensie advocated the building of two state roads; one from Elizabeth to Camden and other from Essex Co. to Cape May. Dr. C. B. Ripley said the new Union Co. roads had already paid for themselves; he urged legislation to regulate width of tire and length of axles on all heavy vehicles. Prof. Lewis M. Haupt said that while it cost 15 cts. to haul one ton of freight over the public roads, it only cost 5 mills by railroad, 3 mills by canal, 2 mills by river or lake and ⅜ mill on the ocean to transport the same amount. The convention passed a resolution urging the legislature and the people to take steps to improve the common highways.

PREMIUMS FOR THE BEST GRADUATING THESES OF '92 GRADUATES IN ENGINEERING.

We issued some week ago to every engineering college whose address was known to us, some one hundred in all, the following circular. The motive and intent of the offer contained therein are sufficiently explained in the circular itself and in the appended "note to college authorities" which accompanied it. If by any chance any college failed to receive copies of this circular and note, we beg that its officers and students will understand that the omission is only by inadvertence, and that they will accept this public notice as a substitute therefor. Additional copies of the circular, which reads as follows, may be obtained by anyone interested on application:

There are every year a few graduating theses of especial merit submitted by students of the various engineering schools of the United States. There are others of less pronounced merit which still are deserving of honorable mention. The number of such exceptionally meritorious theses is increasing, and it is desirable that it should still further increase.

To further this end by securing to the authors and their colleges their just credit for such exceptionally meritorious theses, and to secure to the public the advantage of an early and discriminating publication of such of them as can be regarded as contributions to engineering knowledge, the Engineering News Publishing Company offers the following premiums for the best graduating theses, open to any 1892 graduate in any Engineering course of any College of the United States or Canada:

For the best 3 graduating theses. { First Premium, $75. Second Premium, $50. Third Premium, $25

For such other theses as may seem to deserve such recognition, Honorable Mention, accompanied in each case by two years' paid subscription to Engineering News.

The conditions of the competition will be as follows:

1. Competing theses must be sent in by the college authorities, not by the authors. They must be sent in anonymously, both as to author and college, bearing only some distinguishing signature or mark. They must be accompanied by a sealed envelope indorsed on the outside with the same distinguishing signature or mark, and containing within the name, address and college of the author and a certificate from some one of his professors to the effect that the thesis has been examined and is indorsed as one in all known respects worthy of entering such a competition.

2. The examinations and awards will be made by the editors of Engineering News, assisted by such experts in the several branches of engineering as they may select to aid them in reaching a just decision.

3. The basis of selection for premiums will be the same as that used in selecting papers for publication in engineering journals or society proceedings; that is to say, theses will be graded according to their apparent permanent value for the advancement of engineering practice or theory, either as records of original research, or as intelligent and concise discussions or critical summaries of older researches; clearness, conciseness and simplicity of form will be essential merits for a high award.

4. The right is reserved of withholding any or all premiums, in case no thesis of sufficient absolute merit to deserve them shall be received. No thesis not deemed worthy of publication in full in Engineering News will be awarded any premium.

5. Except for special reason stated, not more than one-fifth of the graduating theses of any one college shall be entered for the competition.

6. The right of first publication of all theses awarded premiums or Honorable Mention is reserved to Engineering News, and all theses receiving premiums will be so published.

7. No thesis which has been previously published in full or in substance will be eligible for the competition.

8. All theses competing for these prizes must be received at the office of Engineering News on or before July 20, 1892, and should be sent in as much earlier as possible.

9. The awards will be announced on or before Oct. 1, failing some special cause for further delay. On or before that date all theses receiving neither premium nor mention will be returned by express to their authors. The manuscripts of the selected theses will belong to Engineering News, but the drawings will be returned after publication.

All communications relating to this competition should be addressed to "Editors of Engineering News," Tribune Building, New York.

This circular was accompanied by the following circular note to college authorities:

TO COLLEGE AUTHORITIES: The inclosed announces an experiment which, if successful, will be repeated annually. Its purpose is to give to the five or six out of perhaps 500 graduates who produce especially able theses, either because of special ability or of favoring circumstances, the professional advantage of having their good work made known to the entire profession. It is not intended to interfere with the ownership of the theses by the colleges, nor with their subsequent publication in college or other journals. It is obviously much more to the interest of the authors of creditable theses, however, that they should be selected and paid for as valuable engineering articles by a professional organ of general circulation than that they should appear only in college publications. While it is hoped and believed that this journal will profit by its offer, by obtaining some very good material, its leading and deciding motive was that it would be doing a very good turn to a few specially able or industrious men, such as it is beyond the power of any college as such to grant, by making it generally known to the engineering world that their work was not merely milk for babes, but food for full grown men.

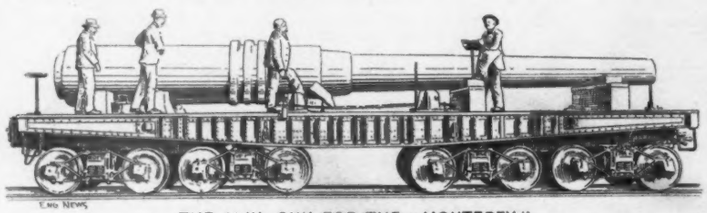
A difficulty which may arise as to a few theses only is that, while perhaps highly meritorious as evidence that the student has profited by his instruction, they are yet too elementary in their nature to have general interest, as for instances, theses working up designs for new structures. After examining the subjects of some hundreds of theses, however, it appears to the undersigned that the subjects of nearly all are of such a nature that, if really well done, they would be "of permanent value for the advancement of engineering theory or practice," and hence be valued contributions to an engineering journal. For the few theses of which this might not be true, the examiners will endeavor, by honorable mention or otherwise, to do exact and equal justice to the merits of the theses as theses.

These explanations are tendered in deference to criticisms offered by two out of a dozen professors in various parts of the country, to whom advance proofs of the inclosed circular were sent with request for opinions. With these two exceptions all the responses heartily approved of the proposed competition and the terms therefor.

College authorities are therefore respectfully asked to make known the inclosed offer to their students who will graduate this year, and to encourage those who have prepared able theses, and none others, to submit copies of their theses for this competition under the terms thereof. Any colleges which for any reason may decide not to permit its graduates to enter their theses in this competition, for other reason than lack of merit, will confer a favor by notifying us of that fact, in order that we may do justice to their graduates by explaining that the competition did not include them.

A HEAVY LOAD FOR LIGHT BRIDGES.

The accompanying engraving shows the new 12-in. rifle for the "Monterey," as it appeared when loaded at the Washington Navy Yard for shipment to San Francisco. A special car was fitted up for its transportation by the Pennsylvania R. R. Co. The side sills of the car are plate girders, 39 ft. long over all, and similar to those used in special cars for transporting wire cables. Equalizing levers distribute the load on each end to two four-wheel trucks of ordinary diamond pattern. The plate girders are 7 ft.



THE 12-IN. GUN FOR THE "MONTEREY."

9 ins. apart, out to out. Their depth at the center is 23 ins., and at this point the clear height above the rail is 2 ft. 7 ins.

The wheel-base of each set of double trucks is 13 ft. 3 ins., each truck having a 5 ft. wheel-base and the axle centers of the adjacent wheels of the two trucks being 3 ft. 3 ins. apart. The total wheel-base of the car is 35 ft. The wheels are 33 ins. diameter. The total weight of the car is 54,800 lbs.

The gun was taken from the shops at the Washington Navy Yard, where it was made, to the Indian Head proving grounds and back by water. The car was run into the gun shop and an overhead crane of 250,000 lbs. capacity picked up the gun and deposited it on the car. The total weight of the gun as loaded on the car was 100,800 lbs. It was stripped of all movable parts before shipment. It was supported on the car by blocks bolted to the car floor, with a block at the center notched to fit the gun and prevent slipping. The gun is 36 ft. 9 ins. long over all, and its largest diameter is 45 ins. Its projectile weighs 850 lbs. and is fired with a charge of 425 lbs. powder. The muzzle energy of the projectile is 25,985 foot-tons, hence its striking power may be imagined by remembering that its energy is equivalent to a train weighing 310 tons, moving at the rate of 50 miles per hour.

The "Monterey" will have two 12-in. guns in her forward barbette and two 10-in. guns aft. The second 12-in. gun is now being rifled at the Washington gun shops; and the two 10-in. guns are nearly completed. The special car has delivered its load at San Francisco and returns at once for the second 12-in. gun. There are now at the Washington gun shops between 50 and 60 guns in various stages of construction.

An interesting question which will doubtless occur to many engineers is: What strain did this car, with its load, bring upon the track and bridges in its run across the continent? It will be noticed that a large proportion of the weight of the gun is carried by the trucks at one end of the car, even more than is apparent at first glance, for the 12-in. bore of the gun makes the muzzle weight very small. We estimate the portion of the load which comes on the rear pair of trucks at 80,000 lbs.; and adding to this half the weight of the car (54,800 lbs.), we have 107,400 lbs. on a wheel base of 13 ft. 3 ins., equivalent to about 8,100 lbs. per lin. ft. This is a concentrated load in excess of that specified in Cooper's "Class A" specifications, which are for a load of 96,000 lbs. on a wheel-base of 14 ft. 9 ins. Cooper's "Extra Heavy A" concentrated loading, however, is slightly greater than the load on this ordnance car, being 120,000 lbs. on a wheel-base of 14 ft. 9 ins, or about the same load per foot on a wheel-base 18 ins. longer.

In this connection the view of a Canet gun of somewhat greater dimensions mounted on two separate cars, which we give in another column, is of especial interest.

TRANSFER BRIDGE FOR NORFOLK & CAROLINA RAILROAD.

[With Inset.]

We illustrate on our inset sheet this week some details of the double-track transfer bridge recently built for the Norfolk & Carolina R. R. at Pinner's Point, Norfolk, Va. The novel, and, in this case at least, economical method of raising and lowering the bridge is the chief claim of the structure to interest. This is done almost entirely by admitting and expelling water to and from the pontoon supporting the movable end of the bridge.

The connection between the bridge and the transfer barges is most commonly made by depressing the bridge by running a locomotive upon it, and raising it by means of the gallows chains, operated either by hand or steam power. This method, as is well known, has several disadvantages, the most serious of which are the breaking of the toggles coupling the barges to the bridge caused by the heavy shearing strain put upon them when the locomotive is run off the bridge, and the difficulty of regulating the depression of the bridge so as to couple easily with a barge careened to one side, and thus having its couplings at different levels.

In this case the difference in height between loaded and unloaded barges at low and high tide is as much as 7 ft. The pontoons are provided with two 10-in. globe valves placed in the bottom, and capable of admitting water fast enough to sink the bridge 6 ins. per minute. The two ejectors for removing the water have 6 in. pipes, and can raise the bridge 2 ins. per minute. Minor adjustments are made by the gallows chains. The steam for the ejectors is supplied from the boilers of a pumping plant located at this point, and belonging to the Norfolk & Carolina R. R.

The bridge is stated to work very well and to eliminate to a large degree the difficulties of operation noted above. It was built by the American Bridge & Iron Co., of Roanoke, Va., and was designed by Mr. Chas. C. Wentworth, the chief engineer, together with the engineering staff of the

company. We are indebted to Mr. Wentworth for the matter shown in our illustrations.

COLUMNS FOR HEAVY BUILDINGS.

By J. Deforth, C. E., of Pittsburg, Pa.

The controversy raised by Mr. Purdy's article on "Steel Skeleton Type of High Buildings" [Eng. News Dec. 5, 12, 26, 1891, and Jan. 2, 1892,] called forth a criticism from Mr. Milliken [Eng. News, Jan. 9 1892], in which that gentleman attempts to prove the superiority of the Phœnix columns over the Z-bar columns. Nobody familiar with the theory of columns will doubt that, from a theoretical standpoint, the Phœnix column is the most favorable section for compression, and cannot, as regards strength, be surpassed by any other known or future form.

But practice does not always meet theory. I do not agree with Mr. Milliken in placing the same confidence in the strength and economy of the bracket connections, designed for Phœnix columns, as I do in those for Z-bars and other sections. By referring to the accompanying figures, in which I propose some new sections, for heavy loads, made up of commercial shapes, or such as can be easily rolled, I have endeavored to show the comparative value of the different bracket attachments to the webs of the single and combination columns.

The heaviest 8-seg. Phœnix "G" column of 92 sq. in., Fig. 1, is very strong for carrying direct loads,

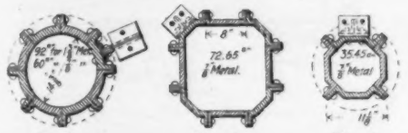


Fig. 1. Fig 4. Fig. 2.

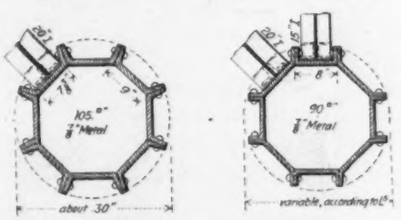


Fig. 5. Fig. 6.

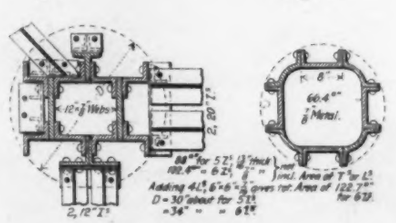


Fig. 7. Fig. 3

Sections of Columns for Heavy Buildings.

but the poor little brackets between the flanges are entirely insufficient to transmit the load they are intended for to the web and thence, according to Mr. Milliken, in an angle of about 45° to the whole section. The brackets are only good for about 30,000 lbs., using three ⅞-in. diameter rivets in double shear through the support angles to take up the load. These angles will receive just as much of the pressure as their bearing surface proportions for them, and the gusset carries only a small part directly.

In all the brackets for Z bars the loads are applied very close to flanges or webs, and the bracket angles supported by light fitting stiffeners, which are fastened to the column by the number of rivets required for single shear or bearing. In brackets attached to Phœnix columns in the usual manner there is not only an insufficient number of rivets to provide for the shear of the bracket angles, but also a considerable tension at the joint next to the column flange, which is only resisted by the gusset.

This defect is certainly more objectionable than the slight warping of Z-columns, on which Mr. Milliken puts so much stress. Angles are more subject to twisting in coming from the rolls than Z-bars, and Phœnix segments are not exempt from this objection, as the writer has seen riveted up Phœnix columns the seams of which were spiral and the columns anything but straight. It requires some care to straighten Z-bars, and probably Phœnix segments also, but it can be done, and no bridge company or builder is obliged to accept warped shapes from the mill or finished columns that are not straight.

The most effective improvements in Phœnix columns for buildings would be:

1. Rolling segments with longer flanges, to enable bracket angles to run over same.

2. Combination of Phœnix segments with channels, in order to rivet directly onto the web, in the same manner as is shown in the other figures. The combination would place the Phœnix channel column below the trough sections and the Keystone channel column as the best for distribution of metal adaptability to connections. In the latter respect the Keystone channel column is superior, while, in regard to strength, both sections are about the same for like conditions.

The segments for the trough sections, Figs. 2, 3, can be rolled in different shapes and combined in either four, six or eight-segment columns. The proposed section, with the swelled web, in Engineering News of Jan. 9, 1892 (Fig. 1 of that issue), is a good one, but thickness of web in the middle should not exceed 1 in. on account of punching. The metal of this column is not so well distributed as in the Phœnix, Keystone and trough columns, besides which beams running in any direction can be better supported by a polygonal column, such as the trough column. The same remarks apply to Fig. 2 of that issue and article, and, in addition, the rolling of that shape is certainly more difficult than in the case of Z-bars.

In the proposed trough sections I tried to make the segments wide enough to admit the heaviest 20-in. I-beams between the flanges, which should be sufficiently long to make field connections to them, if repairs are required after columns are riveted up. The Phœnix column, in its present shape, does not permit any field riveting, and connections that may become necessary after the columns are in position must be bolted on through opposite segments.

Mr. Purdy had probably good reasons for piling plates between and outside of the Z-bars in the heavy columns, but the double Z-column, Fig. 7, shows that the metal can be distributed to a much better advantage by placing two columns beside each other and riveting them together or increasing the section and radius of gyration (at least in one direction) by the insertion of plates, tees, angles, etc. The size of web plates can be so chosen that the column offers the same resistance against crushing in both directions.

The great convenience of connections is shown by a few examples. Field connections can be made in a much better manner than with any other section. The area can be increased without resorting to cover-plates to meet almost all requirements for any direct or eccentric loads. With the suggested sections, also, shop work is less expensive than for Phœnix columns or other sections, because less punching and riveting are required. The flanges are wide enough for driving the largest rivets, which cannot be claimed for the Phœnix segments.

Although Z-bar columns are not manufactured in such lengths as the Phœnix columns, yet I do not see any reason why, with perfected methods of rolling, such lengths could not be attained.

Mr. Deforth writes us in a supplementary note:

I have illustrated the different largest sections based on ⅜-in. metal (except ½-in. for 5-in. Z, the heaviest section rolled at present) because this thickness allows punching, and reduces the work in the bridge shops to a minimum. If the 8-segment G Phœnix column of 60 sq. ins. (⅜-in. metal, should be increased to the octagonal trough section shown, it would require eight additional plates of 7⅛ × ⅝ ins., which would, symmetrically placed relatively to the centers of flanges, increase the outside diameter of the column to 29 ins. This example shows the economy of large trough sections, which afford such large area without the addition of filler bars. Should the metal of the large trough sections be increased to 1⅛ ins., the area of the column would be 165 sq. ins. against 92 sq. ins. for the heaviest Phœnix G column. There should be several sizes of trough segments for each shape, 9 ins. being the largest, so that the outside diameter can be reduced to a minimum according to the size of beams used in the building.

THE STATUS OF THE ELECTRIC RAILWAY.

By R. Hunt, Washington, D. C.

The electric railway is an American invention, and the development of this modern system of locomotion has been, so far, also American, with minor exceptions. The amazing rapidity of development is indicated by the fact that in the year 1888 there were only a dozen electric railways in the United States, operating about 48 miles of road with 95 cars, and that on July 1, 1891, there were 354 such railways, operating nearly 3,000 miles of road with 4,513 cars.

The question naturally suggests itself in the face of the rapid advance of electric traction in so short a period of time, what are the inherent benefits of such a general system and why should it succeed rather better than any or every other? The way, of course, to look for a correct answer is to analyze the money-making capacities of the various forms of locomotion now in use in the street car service of the United States. This has been done as thoroughly as possible in many recently published estimates, but it is yet too soon to regard such estimates as really decisive. As was stated by Mr. Badger, of the Edison Co., in an address delivered at the convention of street railway managers held at Pittsburg, electric machinery exhibits wide variations in its performance under different conditions. Thus the case was cited of one road in which one in six of the armatures had to be repaired monthly, whereas another road made an armature last nearly a year without repairs. Also on one road a constant leakage of from 20 to 30 amperes was shown to exist.

In this report an elaborate comparison was made between electric, cable, and horse power street railways, (already published in Engineering News, Oct. 24, 1891), in which tables of expenses were submitted from 22 electric, 45 horse and 10 cable railways. An examination of the figures shows that the expense of laying an electric railway is less than 15% greater than the expense of laying a horse railway; while it is a little more than one-ninth the cost of building a cable railway. The average cost per passenger carried on the electric roads was 4.53 cts., on the horse lines 4.98 cts., and on the cable lines 4.77 cts. The Census Bureau in Bulletin No. 55, dated April 24, 1891, (abstracted in Engineering News, May 23), gave statistics of 50 lines of street railways, 10 of which were operated by electricity, 30 by animal power and 10 by cable. The operating expenses per car mile were 13.21 cts. for electric lines; 18.16 cts. for horse lines, and 14.12 cts. for cable lines. The operating expenses per passenger carried were 3.82 cts. for electric lines, 3.67 cts. for horse, and 3.22 cts. for cable lines.

It is evident from these and other estimates that, so far as the operating expense per car mile is an index of economy, the electric road is the cheapest; and according to the figures submitted to the Pittsburg meeting the expense per passenger is also cheapest by electric traction.

The question of choosing between subterranean lines and aerial lines appears to have been settled, for the present at least, in favor of the latter, so far as our country is concerned.

Subterranean lines may be divided into two general systems: the underground, properly so called, in which there is mechanical contact with a conductor inclosed in a subway, and the system in which there are electromagnetic stations situated at the surface at intervals.

In the United States the first system is yet in an experimental stage. Some electric railway promoters have declared it impracticable, because the drainage from the streets of most cities is so defective that no means can be devised which will prevent the subway from filling up with water and mud. The other system, no matter how ingenious it may appear theoretically, requires a continuous conductor as well as a sectional wire, and so cannot be made to work advantageously under the same conditions.

It would thus appear that, although the subterranean systems are condemned as unsatisfactory, it is rather because of the local difficulties attending the working of such lines than because of any defect in the principles involved. This is the case in reality, for already there are several underground lines in Europe that work admirably.

The aerial or trolley type of electric railway may also be divided into two principal systems: One in

which the line is continuous, and the other in which the line is divided into sections. The first of these systems is preferable whenever it can be employed, which is not always possible in some cities. In both systems the wires are strung overhead on poles, and should be most carefully insulated. The return by the earth should also be perfectly protected.

The wire used in aerial trolley systems is made of copper, silicon bronze or phosphor bronze. The best material is hard wire-drawn copper, the diameter of the wire to be about ⅛-in.

The wear and tear on such a wire is very slight, except at crossings and on curves, as only the wheel of the trolley is brought in contact with it. In consequence, it is advisable to guard against the use of trolley rollers with iron tires; the iron cuts the cable. Also, it should be remembered that the replacing of rollers is less expensive than the repairing of the cable, and the handling of the cable is sometimes attended with danger.

Leaving out of consideration the crossings and curves in an overhead cable, it is estimated that a good copper wire can stand constant usage for more than 20 years with the cars passing any given point at the rate of one every six minutes for 18 hours a day. Thus far in the history of overhead trolley systems no wire has been known to break except from accidental causes, such as the falling of a telegraph pole.

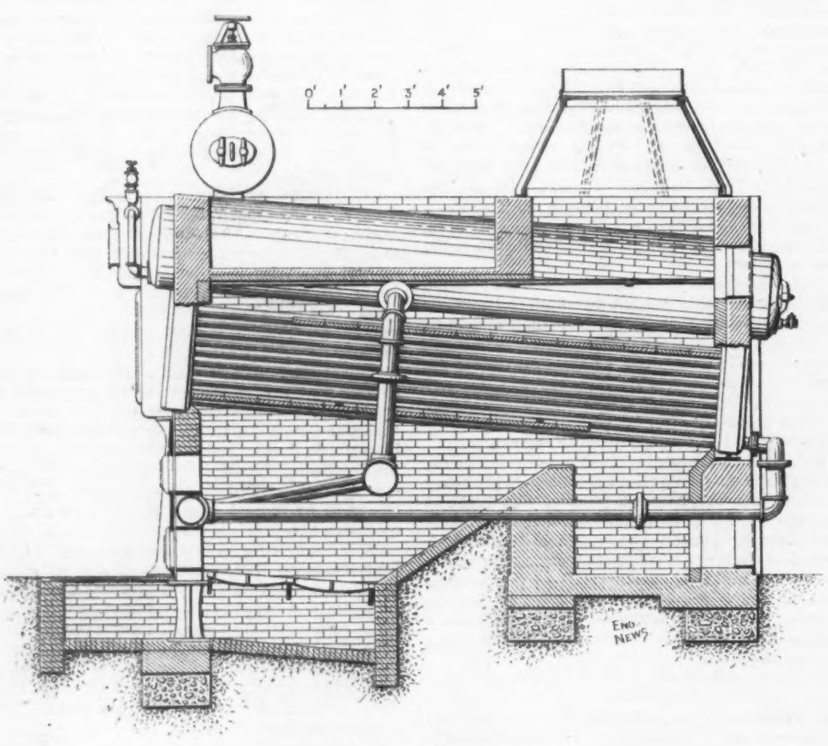
The speed maintained by electric cars operated by means of the overhead wire system averages 8½ miles an hour, and as high a rate of speed as 20 miles per hour has been attained. The grades of the roads in the United States rarely exceed an average of 6%, though in some instances they reach 10%, and on the Amsterdam road in New Jersey a gradient of 12.5% is found; 52 people have been carried up this grade, and at Nashville, where the incline is 10%, 77 persons have been taken up.

Finally, it is but fair to state that, however objectionable the trolley overhead system may be, nothing has thus far in occurred its application which has proved it to be an unsafe method.

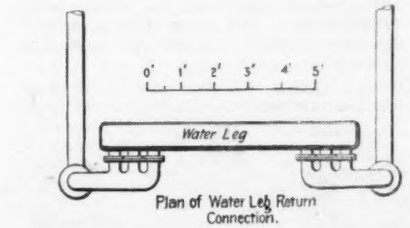
In all that concerns the application of the accumulator or storage battery system to electric traction, little can be said. It is believed, however, that in the future it will supplant all other modes of car traction. For the present the objections raised against it are that the accumulators and the necessary connections will not endure for any length of time; that their bulk and the difficulty of manipulating them are insurmountable; that their dead weight is so considerable as to render the cars useless on steep grades; and finally that the cost of operation is out of all proportion to the receipts, especially when compared with other systems.

However true all the above may be, it would seem that were there a demand for the accumulator car, and did our municipal authorities insist on its adoption to the exclusion of the overhead wires, means would be found for satisfying all the required conditions.

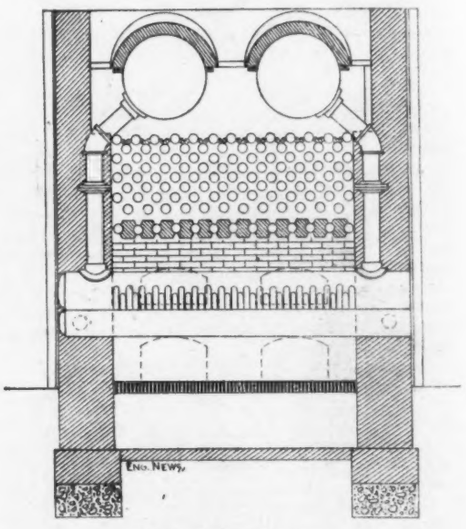
In concluding this sketch of the electric railway situation, some mention should be made of the road to be opened at the Columbian Exposition by Mr. Edison. As usual, this new Edison system embodies no very novel idea. Stated in brief the system in question may be described as follows: A high potential current is transmitted at a potential of 1,000 volts to a number of motor transformers, situated below the roadway, which transform it to a current at 20 volts and 100 amperes. These transformers are connected to the rails, from which the current is taken by the car as it passes over them. It was considered that such a contact should be able to pick up the required amount of current through two inches of mud and this is said to have been done. The cost of a double line of track completely equipped is estimated by Mr. Edison to vary between $30,000 and $100,000 per mile.



Sectional Side Elevation.



Plan of Water Leg Return Connection.



Sectional End Elevation.

THE HAWLEY DOWN-DRAFT SMOKELESS FURNACE ATTACHED TO 250-HP. HEINE BOILER.

THE HAWLEY DOWN-DRAFT SMOKELESS FURNACE.

In our issues of March 23 and Sept. 7, 1889, we illustrated and described tests upon a steam boiler with a "down-draft" furnace, controlled by the Complete Combustion Co., of Boston, the air entering above the grate and passing downward through the burning fuel to the ash-pit and thence to the tubes. The boiler showed an excellent economy, evaporating in one trial 11.78 lbs. of water, and in the second trial 10.20 lbs. of water from and at 212° per lb. of best dry Cumberland coal. In our issue of Aug. 2, 1890, we illustrated the same device attached to a locomotive on the Portland & Ogdensburg (Maine Central) R. R.

We illustrate herewith another type of down-draft furnace which has been in use for some time at Springfield and at St. Louis, Mo. Tests have recently been made of a steam boiler fitted with it at the works of N. K. Fairbank & Co., Chicago, Ill., under the direction of Mr. O. G. Burnham, chief engineer of the works.

The boiler tested was a plain tubular boiler 5 ft. in diameter, 16 ft. in length, with 48 4-in. tubes, 944 sq. ft. of heating surface, and 20 sq. ft. of grate surface. The boiler was given a 6 hour test with Jackson Hill lump coal, and also a 6-hour test with Indiana screenings. The steam pressure was 90 lbs. and the feed temperature was 130° F.

A 6-hour test was also made of a tubular boiler 54 ins. × 16 ft., with 39 tubes 3½ ins. diameter, having a furnace and grate of the ordinary style. The grate surface was 20 sq. ft., as in the previous tests, and the total heating surface of the boiler was 710 sq. ft., or only 75% of that in the boiler tested with the Hawley furnace. The steam pressure was lower being only 50 lbs., and the feed water temperature was higher, 170° F. The fuel used was of much better quality than in either of the other tests, being Hocking Valley lump coal, costing $3.50 per ton.

The following table summarizes the results of the three tests:

	Hawley furnace.		Common furnace.
Kind of fuel	Lump coal.	Screenings.	Hocking Va. lump.
Water evaporated, lbs.	20,900	19,475	20,415
Water evaporated per hour, lbs.	3,483	3,245	3,412
Coal burned, lbs.	3,100	3,400	2,850
" per hour, lbs.	516	566	475
Water evaporated per lb. of coal, lbs.	6.7	5.7	7.11
Evap. from and at 212° per lb. of coal, lbs	7.5	6.4	7.66
HP. developed at 28 lbs. steam per HP. hour	121	115	113.4
Sq. ft. heating surface per HP	8.1	8.2	6.2
Coal per sq. ft. grate per hour, lbs.	25.9	28.	23.5
Ash (non-combustible), lbs.	425	425	160
Cost of fuel per ton	$2.60	$1.60	$3.50
" " per 1,000 lbs. water evaporated	19.25 cts.	14 cts.	24 cts.

It is stated that in both the tests with the Hawley furnace, the chimney was practically smokeless; and this is indeed the point of greatest practical

interest with regard to the device. If, as is claimed, cheap grades of coal can be burned in this furnace by a fireman of ordinary skill with absolute freedom from smoke, then this system of furnace construction may well claim the attention of engineers and steam users who burn soft coal. About 40 of these boilers are now in use in St. Louis and are stated to be giving excellent records for fuel economy and durability, and to be a practical success for the prevention of smoke. The boilers equipped with this furnace, with those under contract, aggregate nearly 7,000 HP.

Another test of this furnace was made on Dec. 24 at the Schneider Brewery, in St. Louis, under direction of Chas. E. Jones, instructor in forging at the Washington University Manual Training School, Nels Johnson, of the St. Louis Water Department, and Thomas H. Nelson, Master Mechanic of the Heine Boiler Co. The boilers tested were a battery of three return tubular boilers, each of 66 ins. diameter and 18 ft. length, with 60 tubes of 4 ins. diameter. The total heating surface of the plant was 2,834.6 sq. ft., and the total grate surface was 50 sq. ft. The fuel used was Collinsville (Ill.) lump coal. The nominal rating of the boilers was 300 HP. The test was of 8 hours duration. Its principal results are given as follows:

Percentage of ash	11.44
Average steam pressure, lbs.	9.224
Ave. temperature of feed water	147.2° F.
Draft pressure, ins. of water	0.74
Water evaporated per lb. of coal, lbs.	6.95
" " " from and at 212°, lbs.	7.69
" " per sq. ft. heat surf. per hour, lbs.	1.12
Sq. ft. heat surf. per HP. (at 28 lbs. steam per HP.)	6.8
Coal per sq. ft. grate surf. per hour, lbs.	31
Percentage of moisture in steam,	1.36

During the 8-hour test no smoke was visible from the smokestack except at three short periods of about one minute's duration each. Analysis of the escaping gases showed an almost total absence of carbonic oxide.

We illustrate herewith the furnace attached to a 250 HP. Heine water-tube boiler. As seen by the drawing, there are two separate grates, one above the other. The upper grate is a series of inclined tubes, through which water rapidly circulates. The coal is fired on this grate; and the tubes being rather widely spaced, as the coal becomes coked and partly consumed it falls between these tubes upon a lower grate of rocking bars. When fresh coal is fed to the upper grate the gases pass down through the incandescent mass of fuel, and are so heated by this and by the flame from the lower grate that complete combustion ensues in the space between the grates.

The chief feature of the furnace (which is covered by U. S. Patent No. 447,179, issued to M. C. Hawley, Feb. 24, 1891,) is the combination of the two grates, substantially as described above. The connections for the water-tube grate are varied according to the style of boiler to which the furnace is applied.

We believe that the original inventor of this furnace was Mr. M. Kearney, of Springfield, Mo., master mechanic of the St. Louis and San Francisco Railway. Three boilers fitted with the furnace are in use at the railway shops at Springfield, and are stated by the superintendent of rolling stock, J. R. Groves, to be good steamers with cheap coal, economical in repairs, and practically smokeless. We also understand that there is no trouble with scale or sediment in the tubes of the water grate.

The Hawley Furnace Co., which controls this apparatus, has its office and works at 128 and 130 So. Clinton St., Chicago. Mr. S. T. Bleyer is the general manager.

THE ADDITIONAL WATER SUPPLY OF MERIDEN, CONN.

The city of Meriden, Conn., has just completed an addition to its water supply at a cost of about $210,000, including land damages. The present gravity supply was introduced in 1869, and has been ample until the last few years. Investigations for a new gravity supply not developing any satisfactory sources it was decided to build a storage reservoir and a pumping plant on John Hall Brook, 5¼ miles to the north of the city, and to build a new distributing reservoir and so provide an independent supply in place of pumping into the old reservoir. Work was begun about June 1, 1891, and completed in December 1891. The storage reservoir has a capacity of 133,000,000 gallons and a drainage area of 1¾ square miles. Additional reservoirs may be constructed above, and other watersheds diverted as the needs of the city require. The pump is a 5,000,000-gallon Knowles compound duplex condensing with a guaranteed duty of 65,000,000 ft.-lbs., and has made a very satisfactory test. The force main is 2¾ miles long and rises 188 ft. The supply main from the distributing reservoir is 1¾ miles long and each main is 20 ins. in diameter.

The distributing reservoir is a natural basin on the direct line from the pump to the city, with its water line 391 ft. above mean low water, 291 ft. above the railway crossing on Main St., and 22 ft. above the old reservoir.

The dam of each reservoir is of earth with a puddled core, a top width of 15 ft., inner slope of 2½ to 1, paved, and outer slope of 2 to 1.

The storage reservoir covers 30¼ acres and has 33 ft. of water at the gate-house. The dam is 1,000 ft. long, the greater part of the fill being in 400 ft. of its length. The whole embankment contains 48,000 cu. yds. The waste way is 125 ft. in length and is separate from the dam.

The distributing reservoir covers 4¼ acres, has a capacity of 15,000,000 gallons and a depth of water at gate house of 18½ ft. The dam is 475 ft. long and the embankment contains 16,000 cu. yds. The waste way is 10 ft. wide, cut through rock at one end of the dam. The drainage area is 30 acres.

Meriden has an estimated population of about 25,000 (21,652 according to 1890 census) and the consumption of water is estimated at 2,000,000 gallons per day.

The new supply is intended for use only when the present supply is inadequate, and the conditions are such that when the present supply is low, and the new in use, any surplus pumped into the new distributing reservoir may be carried to the old reservoir through a 16-in. main connected with the new 20-in. main; the pump may thus be run continuously at full capacity without waste of water. The increased pressure from the new supply is also readily available in case of fire, an item of no little importance when, as must often be the case, the old reservoir is low and the pressure reduced.

No especial difficulties were encountered in the work, the pipe-laying being the most difficult, as portions of the line were very rough, and the rock almost continuous.

The storage reservoir was built by J. W. Buck & Co., of Danielsonville, Conn., and the distributing reservoir by Mr. H. E. Stanton, of Huntington, Mass. The pipe was laid by Mr. C. H. Eglee, of Flushing, N. Y. Mr. E. N. Pike, of South Killingly, Conn., to whom we are indebted for the above information, was engineer with Mr. Geo. H. Bishop, Mem. Am. Soc. C. E., of Middletown, Conn., as consulting engineer.

CONTINUOUS BRAKES ON ENGLISH RAILWAYS.

In an editorial note in our issue of Dec. 19, 1891, we referred to the unreliability of the face of the returns of brake failures made by the English railway companies to the Board of Trade. The "Railway Engineer," of London, referring to the use of the Westinghouse brake on the London, Chatham & Dover Ry., says that it considers that company's return for the first six months of 1891 as "a disgrace to even such a line as the Chatham is." According to the return this road ran 23,867 miles with the vacuum automatic brake without a failure, but with 1,559,486 miles made with the Westinghouse automatic brake, the company reported nine cases of failure or partial failure under ordinary circumstances, and 41 cases of delay due to defects in or improper action of the brakes. This means a failure of some kind per run of 31,190 miles. The company reported 147 engines and 1,063 cars fitted with the Westinghouse, and two engines and 12 cars with the vacuum brake. The London, Brighton & South Coast Ry., however, which has used the Westinghouse automatic brake for many years, and has 354 engines and 2,644 cars fitted with it, reported having run 3,546,988 miles with only eight cases of delay due to defects in or improper action of the brakes, or only one such case to 443,373 miles. The "Railway Engineer" comments as follows upon the results:

> This vast difference between the two companies must be due either to the brake or to the men who work it, and we are inclined to think it is the latter, for none of the Brighton faults are ascribed to the men, whereas several of the Chatham are, there being also on that line a considerable number of mysterious faults about the causes of which nothing can be ascertained. We think no clearer proof has ever been seen of the contention that to operate the Westinghouse brake does require considerable experience in handling before it can be said to be really reliable in the hands of an average driver, than the above quoted results of its working.

It is undoubtedly true that the Westinghouse brake is the most reliable in operation when handled by men who understand its working, in the same way that locomotives are operated to the best advantage when handled by experienced men who understand the mechanism and principles of their working. This is fully recognized in this country, and the principal roads take steps to ensure, by printed and personal instructon, that enginemen and trainmen understand intelligently the working of the Westinghouse brake. The "Railway Press," of London, in an article on "Maintenance of Continuous Brakes," commenting upon the poor showing of the London, Chatham & Dover Ry., takes this same view as follows:

> For some considerable time past complaints have reached us with reference to the want of proper maintenance in good working order of continuous brakes by the London, Chatham & Dover Ry. Co. This is a very "penny wise and pound foolish" policy, which if continued will certainly land the company and perhaps some of its servants in trouble. Looking to p. 50 of the last brake return, we find that 147 engines, working only 1,550,000 miles, have had no less than 50 faults upon the Chatham & Dover line; and when examined they show two things: first, that the brake is badly cared for, and secondly, that those who work it in many cases have not had proper instruction, as the cases are put down as "error on driver's part," "error of judgment on part of driver," "fault of company's servants." Our opinion is that such reports do not do justice to the men, for most of the instances are due to defective maintenance by the company; and as to "inexperience" of servants, what else can be expected if men are not properly shown how to work the brakes? On the Northeastern Ry., for instance, we see there is a proper "brake instruction van," showing every part, and all who wish to learn can do so. Why does not the Chatham & Dover have a similar van?
>
> Let us now compare the working of the brakes on the Brighton Ry. Here we see 354 engines running 3,546,988 miles, and only six faults, not one being due to the men. The Chatham men we know to be every bit as good as their fellows on the Brighton: what is done on the Brighton can be done on the Chatham; so the sooner the Chatham Co. turn their attention to better 'maintenance" of the brakes and to the adoption of an "instruction van," the better for them, their servants and the safety of their passengers.

The London, Chatham & Dover Ry. is one of the Southern systems, and like the Southeastern Ry., is in many respects very far behind the times. This is particularly the case in regard to the passenger equipment, and even "The Engineer," of London, which objects to American criticism of English railways, stated in a recent issue that the company would do well to spend some money "in replacing a lot of its disgraceful, dirty, wornout stock with some that is cleaner and safe, and in a better and cheaper mode of lighting."

RAILWAY EXTENSION IN INDIA.

According to figures published in "Indian Engineering," very considerable extensions to the railway system of India are under way and projected, and we summarize these figures in the accompanying table. The statement is an attempt to show at a glance the existing position and probable future with regard to railway construction and extension, and it is stated that it is assumed to contain nearly if not all the schemes that can be dealt with or that are likely to be dealt with in the present decade, which will be fortunate if even such a result as the addition of 10,000 miles can be made to the existing mileage at a cost of say $300,000,000, or about $18,750 per mile. The present length of the railway system is about 16,000 miles, of which about 10,000 miles are of the Indian standard gage of 5 ft. 6 ins., and 5,500 miles of metre gage.

	Gage.			Total
	5 ft. 6 ins. Miles	3 ft. 3¾ ins. Miles.	Various. Miles.	Miles.
Under construction..	876	520	200	1,596
Surveyed and sanctioned	2,325	985	460	3,770
Surveyed, not sanctioned	1,525	60	85	1,670
Under survey	1,110	....	130	1,230
Proposed	4,850	1,910	250	7,010
To be converted or duplicated	674	50	....	724
Total	11,360	3,525	1,125	16,000

A LARGE CANET GUN FOR JAPAN.

The Canet type of gun is one of the very latest of modern high power cannon, and the following description, from a late issue of "Le Génie Civil," will be interesting to our readers at a time when our own government is engaged in the manufacture of ordnance of similar calibre and power.

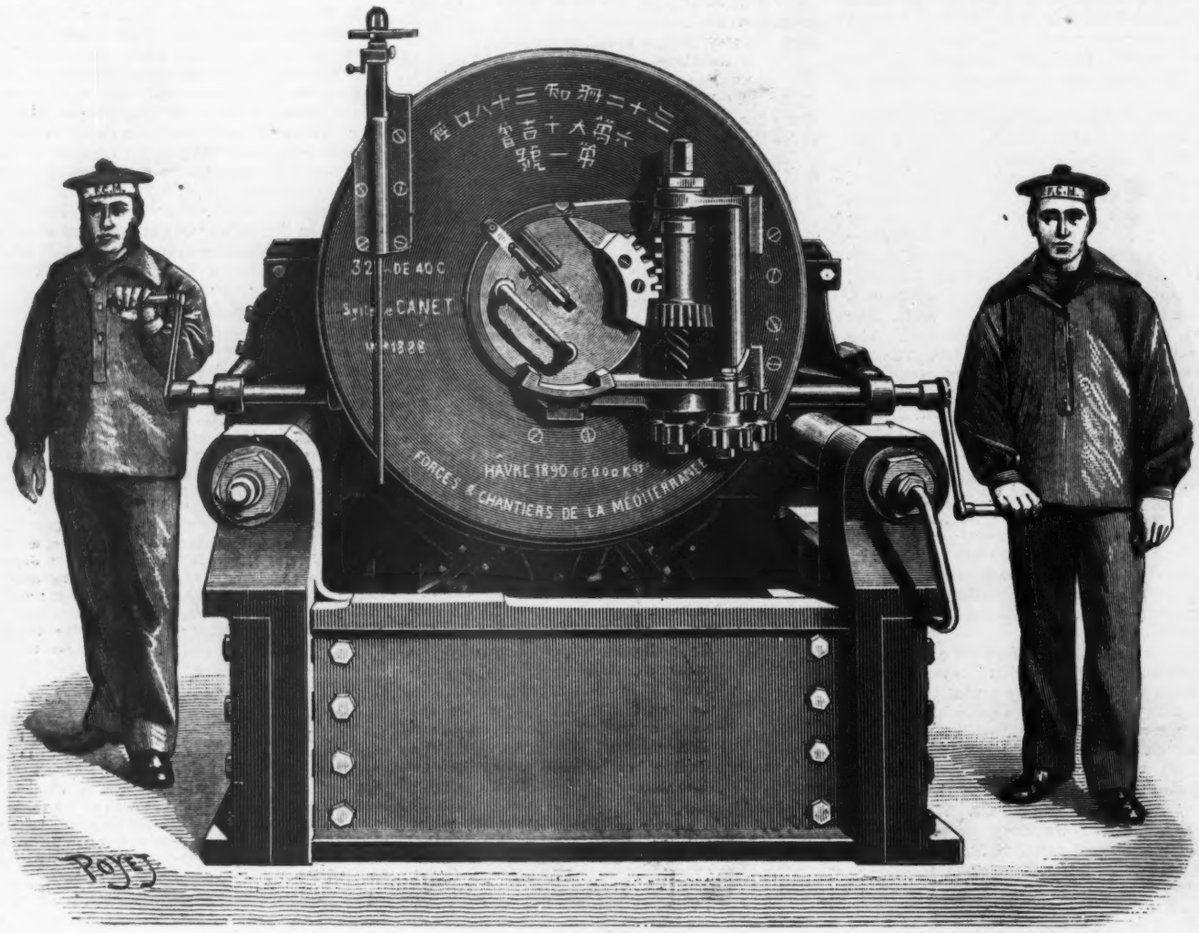


FIG. 1. BREECH MECHANISM OF 66-IN CANET GUN.

The gun here described was made by the Société des Forges, of France, for the Japanese Government, under a contract to arm three 4,200-ton cruisers which are being built in France for Japan. This gun has a bore 12.6 ins. in diameter, and is "40 calibers," or 41 ft. 10 ins., long from end to end of gun proper. It weighs 65.8 tons. It is made entirely of steel, the inner tube being nearly 42 ft. long, and is reinforced or built up with sleeves of varying lengths and thicknesses. The system used in assembling these guns was invented by M. Canet, the director of ordnance for the makers above named, and the steel used in the tubes, hoops and jackets is comparatively soft, quite elastic and of unusual tensile strength. The steel used in the breech mechanism is relatively hard. The U. S. N. 12-in. gun is 36 ft. long, and weighs 45.2 long tons.

Quoting from the "Annual of the Office of Naval Intelligence" for June, 1890, the main characteristics of the Canet system are given as follows: The inner tube, extending the whole length of the gun, is of great thickness, as compared with the English and German guns. A jacket and a sleeve are shrunk upon the rear end of the tube, and are connected at the joint by a trunnion ring, which latter butts against a shoulder of the jacket, and is screwed on to the sleeve. These coverings extend well beyond the trunnions, and, with a layer of broad steel hoops extending to the muzzle, give great longitudinal resistance, and enable the tube to withstand the great pressure due to smokeless powder. Over the jacket and sleeve are then shrunk one or more layers of steel hoops varying in number and thickness with the size of the gun. All parts vary gradually and uniformly in thickness, and all bearing surfaces are cylindrical. It is claimed that this method of assembling gives as great a resistance longitudinally as transversely.

The Japanese guns here illustrated have been thoroughly tested, as many as 20 shots having been fired from one gun. At the last trial of the series, on Oct. 2, 1891, the following results were obtained:

Wt. of projectile. Lbs.	Wt. of charge. Lbs.	Initial velocity. Ft. per sec.	Pressure. Tons per sq. in.	Perforation of forged iron.
750.2	264	1,669.5	5.15	"
755.7	352	1,978.0	9.25	"
997.7	528	2,360.0	17.38	43.3 in.
995.5	528	2,350.0	17.92	43 "
988.9	528	2,360.0	17.31	43.68 "
993.3	556.6	2,345.2	17.72	55.61 "

An examination of the gun made after this test revealed no trace of fatigue in the cannon or in its carriage, and the breech mechanism was particularly easy in its manipulations. Prown prismatic powder was used in the trials, and the weights of charge adopted were 528 lbs. for the armor piercing projectile and 352 lbs. for the ordinary projectile. This powder is very slow in its action and requires special means of ignition. From a ballistic point of view the Canet gun showed a very flat trajectory, so much so that at a range of about 5,000 ft. it will not lift 20 ft., or over what may be called the mean elevation of a ship above the water. The aim, therefore, may be point blank. This flatness of trajectory is of the utmost importance, because errors in judging distance and a lack of precision in pointing are reduced to a minimum. As every shot costs a large sum of money, the importance of making every projectile effective is evident.

The features of this Canet gun are then compared with the cannon of other countries, as follows, the tabulation being ours. We add to it some corresponding figures for our own 12 in. gun; the service charge is 425 lbs.

Type of gun.	Wt. of gun. long tons.	Wt. of of projectile.	Velocity, ft. per sec.	Perforation of forged iron.
Armstrong, 16 ins.	111 tons	1,796 lbs.	2,148.4	47 ins.
Krupp, 15.6 ins....	119 "	2,028 "	1,804	49 "
Canet, 12.6 ins.....	65.8 "	995 "	2,260	47 "
				Steel armor.
U. S. N., 12 ins....	45.2 "	850 "	2,100	24.16 ins.

As a result, says "Le Génie Civil," in power of penetration the Canet gun of 66 tons is practically the equal of the much heavier and more costly English and German guns. One kilogramme of metal in the Canet gun corresponds to a live force imparted to the projectile of 171.74 metre-tonnes. In the Armstrong gun this live force is expressed by 158.9, and in the Krupp gun by 148.8 metre-tonnes.

A comparison of the 32 cm. Canet gun with the Krupp 30.5 cm. gun, which is claimed by some German authorities to be its equal, would stand as follows, as given by the journal quoted:

Type.	Weight of projectile.	Initial velocity.	Perforation of forged iron.
Canet, 32 cm.....	995 lbs.	2,260 ft.	47 ins.
Krupp, 30.5 cm.....	1,091 "	2,234 "	45 "

As a final résumé the good qualities of the Canet gun are enumerated as follows: Its condition at the end of the trial, showing no fatigue after 20 shots, some of which were above the normal charge of powder. Notwithstanding the length of the piece there was no displacement of the hoops and no bending or drooping of the tube. A close examination by the star gage at the close of the trial showed no deformation of the interior of the tube. The carriage also most successfully resisted the effect of these 20 shots and did not show the least fatigue. The maximum effort of traction to which this carriage was submitted was 147 tons. The friction brakes worked admirably and the breech mechanism was especially easy to manipulate. And finally, the ballistic properties of the gun enabled a velocity to be obtained in the trial touching

2,394 ft. per sec., notwithstanding the adoption of a projectile relatively heavy for the caliber.

As a matter of interest to some of our readers, at least, we show two views of the latest type of breech-mechanism of this Canet gun. As in the Armstrong and Krupp guns the space for the charge is of larger diameter than the caliber of the gun proper. The opening in the breech of the gun is closed by means of a screw breech plug with interrupted threads swinging on, hinges and operated by the crank shown. The gearing operating this breech plug somewhat complicated in its action; but it is sufficient here to say that while the plug is started out by the sector and rack shown, the final extraction is accomplished by the pinion seen about the middle of the vertical screw, which pinion meshes with the screw threads of the breech plug. The breech plug itself has a central chamber of about one-third its total diameter, and this opening is closed at the front end by a hollow spindle, with a heavy mush-room-like cap of full diameter. Between this cap and the periphery of the plug proper is an elastic substance that by expansion under pressure prevents the escape of gas to the rear; the spindle slides in the plug chamber and upon an axial stem which contains the firing tube. The charge is fired on the axis of the gun; the lock is shown on the closed breech in Fig. 2.

The diameter of the turret shown is 23.6 ft. to the interior of the armor, which is 19½ ins. thick on the lower ring. The cradle upon which the gun lies carries in its lower part the hydraulic brakes for taking up the recoil, and slides upon a carriage, which latter is pivoted by trunnion bearings to a movable platform revolving on slightly conical rollers. Upon this platform are the hydraulic presses for raising and lowering the gun and for vertical pointing. In the center of the turret a blind well leads to the charging platform below. The ammunition hoist is in this tube and the powder charge is sent up in two bags and delivered with the projectile at the rear of the piece on a small carriage running on rails. The loading process is too intricate in its machinery used for a mere description, but is also effected by hydraulic mechanism. The gun and its manipulator are protected by a shield which revolves with the gun, containing but one opening, for the cannon itself. The gunner is protected by a hood with especially heavy armor.

The view showing the method of transporting by

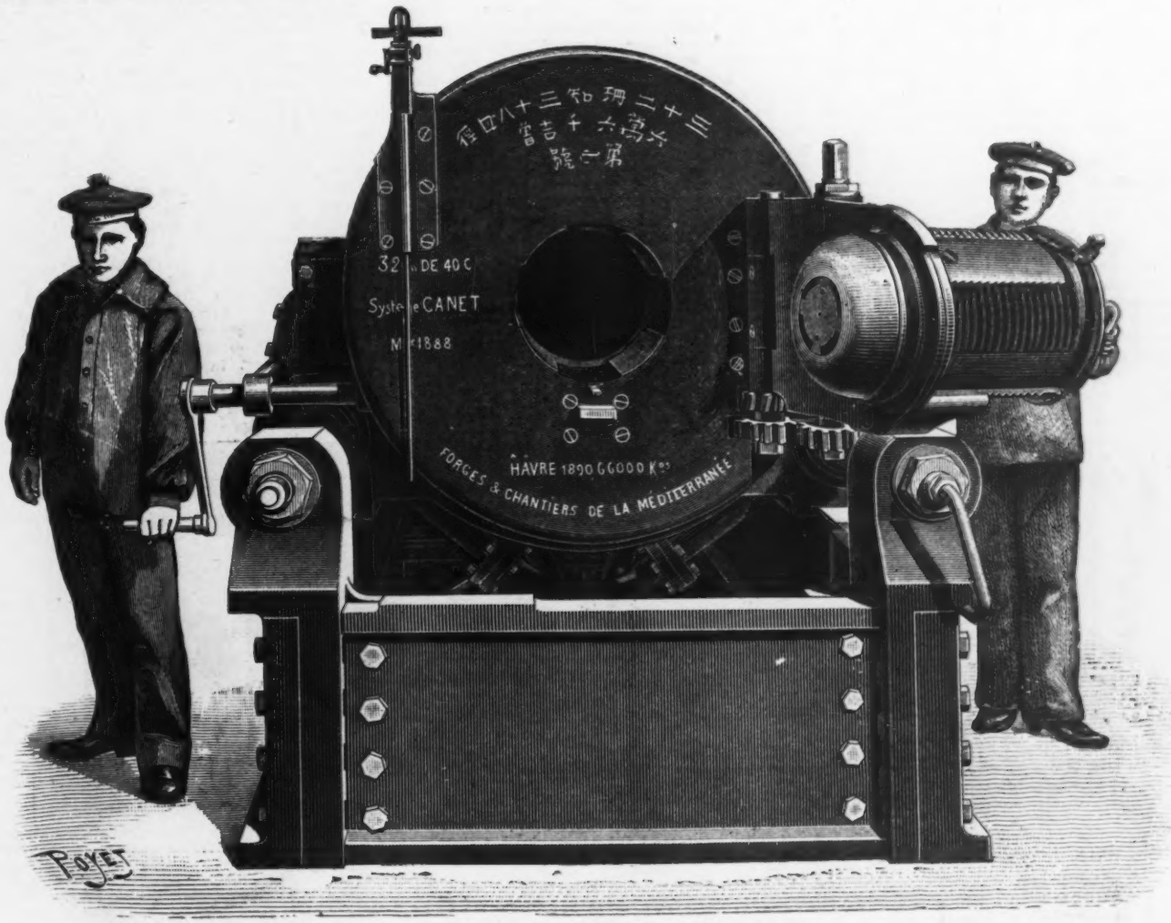


FIG. 2. BREECH MECHANISM OF 66-IN. CANET GUN.

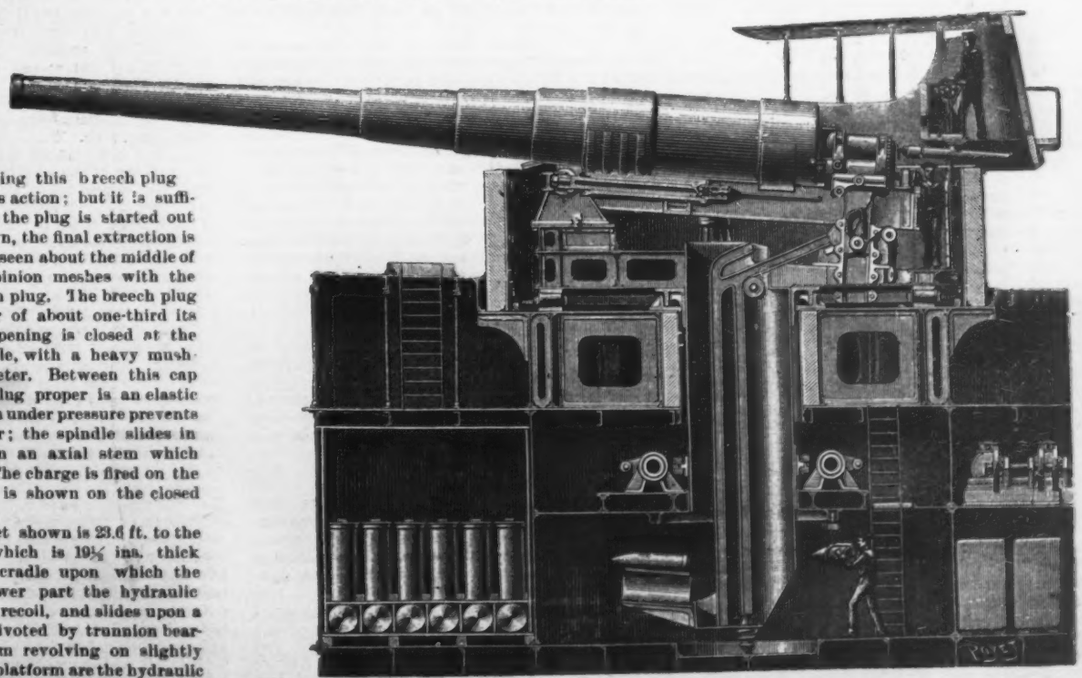


FIG. 3. THE CANET GUN MOUNTED IN TURRET.

rail one of these 66-ton guns is given without explanation as to details; but the cut shows sufficient to make it of interest at a time when our own government has just successfully transported a 12-in. gun to the Pacific Coast.

THE CONSTRUCTION OF LOCOMOTIVE BOILERS.

The following paper was read by Mr. F. W. Dean, M. Am. Soc. M. E., at the last meeting of the New England Railroad Club. Mr. J. L. Speirs' paper at the same meeting was published last week.

I believe it is estimated that there are about 150,000 locomotives in existence, and with few exceptions they have the usual form of staybolt boiler. The inference might, therefore, be drawn that this is the safest type of boiler in existence, as an explosion is comparatively unknown. There is, of course, an occasional explosion, but this should not be placed to the discredit of the boiler.

Let us glance at the service which the boiler performs, and in order to appreciate it, a comparison of its duty with that of stationary boilers is interesting. A stationary boiler when working at an economical rate evaporates some 2 to 3 lbs. of water per sq. ft. of heating surface per hour; but the locomotive boiler evaporates 7 to 15 lbs., or more commonly 10 to 12 lbs. The stationary boiler is allowed 8 to 15 sq. ft. of heating surface per HP., but the locomotive boiler has but 1 to 4 sq. ft. The temperature of the escaping gases of stationary boilers is not much over 400°, while those of locomotives have ranged from 600° to 1,200°, and are very commonly 800°. If the boiler pressure is 150 lbs. per sq. in., a pound of steam occupies a volume of 2.75 cu. ft., and 15 lbs. occupies 43.25 cu. ft. Such a rapid formation of steam calls for a full opportunity to escape, and points to the desirability of overhanging furnace sidesheets.

The severe service to which the locomotive is subjected is more apparent when we consider the amount of coal burnt per square foot of grate per hour. In stationary boilers it is from 5 to 20 lbs., in locomotive boilers from 60 to over 200 lbs. With these consumptions the evaporation per pound of coal is low, with good coal it is 5 to 7 lbs. of water. The boiler is subjected to great and sudden extremes of temperature, for if it steams too freely, the door is opened wide. Recent tests of the quality of steam show that even when working hard the boilers of locomotives send over less than ½ of 1% of moisture, less than is found in many stationary boilers. This is due to large water surface and steam space. No locomotive boiler was ever too large or is likely to be, for the reason that for the economical use of fuel the boiler is always overworked.

The most valuable quality which boiler plate can possess, provided it is not at the sacrifice of any other, is a high elastic limit. A boiler should have its factor of safety determined with reference to the elastic limit, and not with reference to the ultimate strength of the plate. This shows how unnecessary and unwise it is to specify the ultimate strength, except the upper limit in order to prevent an excess of carbon. It is well known that it is easy to secure a high elastic limit in thin plates on account of the amount of work which is put upon the ingot by the rolls. This points to the importance of having thick ingots for thick plates. An ingot about 25 times as thick as the plate to be rolled gives good results.

Beside tests for elastic limit, elongation, and contraction of area, it is well to have quenching and bending tests. This is done by heating a piece of plate to a cherry red, plunging it in water and then bending it over a cylinder whose diameter is twice the thickness of the plate. Most steel will, however, bend down flat under a hammer after quenching without fracture.

For fire plates it is best to be content with a low elastic limit, say 30,000 to 32,000 lbs. per sq. in., and to secure strength by thickness of plates and frequency of staybolts. Test pieces should be long enough to give the elongation in no less than 8 ins., in order to enable us to judge better of the material; for if the length is restricted, we compel the elongation to take place in too small an area to be representative. Every effort should be made to prevent any part of boiler plates being strained up to the elastic limit. Plates can be so strained by punching and flanging. If holes are punched ⅛ in. small and reamed to size, the injured material is mostly removed, but the proper way is to drill all holes in place. When a boiler shop is once fitted for this work the expense is but little greater than for punched work. If reaming is done, it would be better to drill the holes of an inner plate with the outer punched hole as a guide. This assures fairness of holes and avoids eccentric reaming. If both holes are punched, the reamer will become inclined and cause eccentric reaming in both holes and remove only a part of the injured material from each.

A plate-closing ram of a riveting machine, unless used with care, overcomes the elastic limit by making a circular indentation around the rivet hole. Considering that the joint is the weakest part of the boiler, this should be particularly avoided. The elastic limit is often overcome by flanging, and this indicates the importance of annealing plates after flanging. This would probably delay the almost inevitable cracking that takes place in the throatsheets of boilers when they are spread out to join the circular part of the shell. The inner sheets without doubt become annealed in service; so that if they do not crack when new, they are not likely to do so.

The general direction of the circulation in locomotive boilers is upward at the firebox and forward in the upper part of the boiler, downward at the forward end and backward at the bottom. It is obvious that the more freely this natural movement takes place, the more freely the steam escapes. The escape is undoubtedly facilitated by the jar of the engine, and this is an advantage which the locomotive boiler possesses over stationary boilers of any kind. Now let us see what obstructs circulation. It would be obstructed by an insufficient feeding of the water spaces, and for this reason I advocate a very wide front water space in order to properly feed the side spaces. I advocate sidesheets which do not follow the form of the outside sheet, but which are slightly inclined inward, provided no disadvantage follows. When the firebox is between the frames, as is generally the case in New England, this makes a narrow firebox at the top, but it can accommodate a wide tubesheet by being flanged out forward. This has been the practice on the London, Brighton & South Coast Ry. for many years.

Circulation can be facilitated by abandoning transverse crownbars, as they obviously interfere with the upper horizontal current of water. The general circulation in the barrel can be facilitated also by using a large shell and placing the tubes far apart, and by placing the tubes farther apart horizontally at the front than at the back. The inclination of the tubes to the tubesheets is so slight that the tubes are as tight as usual. The writer has practiced this method for several years in stationary boilers. Inclining the sidesheets of the firebox not only promotes better circulation but gives greater elasticity to the upper staybolts by making them longer, and this prolongs their life. The usual method of accomplishing this desirable end is to use enough staybolts at the top to make the structure in that vicinity sufficiently strong and rigid to throw relative movement between the plates elsewhere. The long staybolts would render this unnecessary; or if more strength of stays is necessary at that point, a larger diameter of bolt can be used. Another advantage of the narrow crownsheet is that fewer crownstays are needed, shorter bars can be used if they are transverse, and fewer if they are longitudinal. The longitudinal bars, besides interfering with the horizontal circulation less than the others, permit the longitudinal tie-rods to be placed where they are needed for properly staying the backhead. I have seen some boilers that have these rods dangerously far apart. In order to properly support the longitudinal bars the outer crownsheet should be stiffened with two heavy T irons from which the bars can be supported at two points in each as in English practice.

Next let us examine the form of the boiler about the firebox. A thin flexible shell when subjected to uniform internal pressure takes a circular form and will maintain it when subjected to such pressure, and not otherwise. Let us examine what occurs with a crown-bar boiler under pressure. There are in many cases as much as 200 tons of pressure tending to force the inner firebox downward out of the boiler. How is this pressure resisted? It is resisted by the base or mud ring at the bottom, which tends to rotate (and this points to the advisability of double-riveting this ring), by the stiffness of the stay-bolts, and by connections from the crownbars to the shell above. The crownsheet of course tends to go down, and actually does so, as I have found out by experiment. In doing this it bulges out the curved sides of the inner firebox. In depressing, the crownsheet seeks assistance from the outside crown; but this being a thin sheet in equilibrium from internal pressure, is as unable to resist distortion from this cause as a distended toy balloon is unable to resist the pressure of the finger. It therefore depresses and the sides bulges out. The inner crownsheet goes down, the sling stays receive unequal and absolutely unknown stresses, the upper and other staybolts are bent, and all conditions for overstraining and breakage are present.

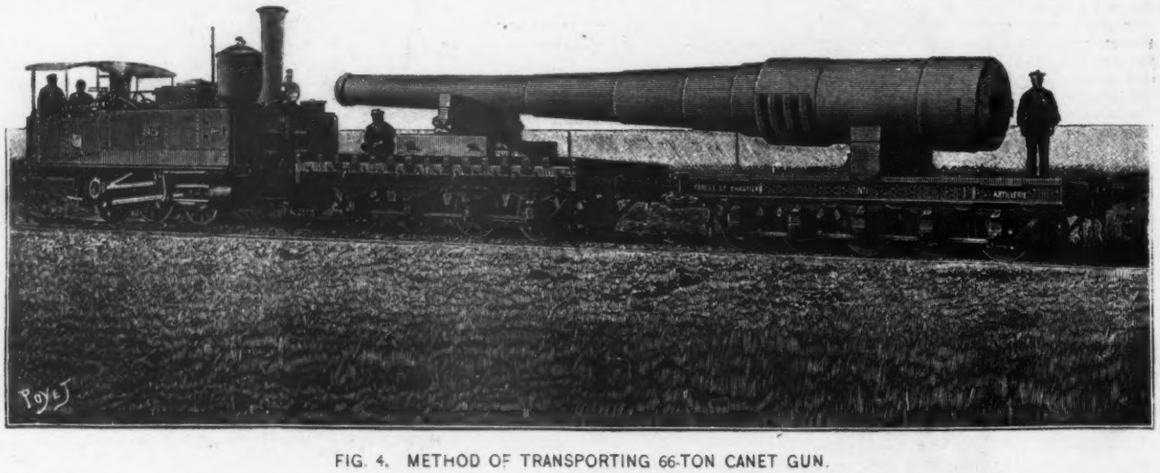


FIG. 4. METHOD OF TRANSPORTING 66-TON CANET GUN.

Transverse tie-rods just above the crownsheet simply modify the unknown stresses, but do not simplify this chaotic condition. This is enough to cause staybolts to break, and in my opinion is the great cause rather than the expansion of the side sheets. The depression of the outer shell forcing out the sides assists in cracking the upper part of the throatsheet. Another common feature of construction assists in this last phenomenon. I refer to the common practice of not giving a circular form to the outer crownsheet; not that this would do any good to this sheet, but it would give circular cross sections to the conical part of the shell immediately in front, thus avoiding a flat place on each side. This flat place tends to bulge out and assists in cracking the throatsheet.

The radial stay system has the same faults as far as stresses in these parts are concerned. When the boiler is under pressure the stays sustain unequal and unknown stresses and many parts must be dangerously strained. The Wootten variety of this form is an extreme case and its weakness is more apparent. If we take a cross section of this we shall see that the pressure acts upon the sides as it does upon a Bourdon tube in a steam gage and it tends to straighten out as the tube does. It is easy to see that the tendency is to pull the staybolts out of the thinner sheet. This shows the necessity of tying the sides of the mud ring to each other at intervals. My own opinion of all the forms of boiler thus far described is that they are unsafe. Any structure in which the stresses cannot be computed is likely to be unsafe.

Now let us see if there is not some form of boiler which is free from all of these defects, in fact a boiler which possesses nothing but virtues. If we had a boiler which tends to lift up the crownsheet as much as that sheet tends to go down, it is evident that there would be no pressure tending to force out the firebox, to rotate the

base ring, to bend the staybolts, to render computations useless, and to distort the outer shell. The Belpaire firebox, named after its distinguished inventor, has these qualities, and the principle of its design is this, that any flat surface of the inner firebox has a companion equal flat surface upon the outer. This permits the corresponding surfaces to be stayed together by stay-bolts of various lengths, and all pressures are perfectly balanced. Moreover, as the stayed plates are flat, they are elastic and yield to movements produced by changes in temperature. Every part can be properly stayed, the stresses properly computed, and the conditions of stress are not changed when the boiler is hot.

This boiler is safe with any pressure for which it is designed. As the crownsheet does not go down, staybolts will break less than in any other boiler. Circulation is free over the crownsheet, water surface and steam space are great, and longitudinal tie-rods can be placed where needed. The weight is a minimum, because every part is proportioned for its stress. With this boiler carefully designed, I should not anticipate any cracking of the extremities of the throatsheet.

Of course boilers of this kind can be imperfectly worked out, and trouble will follow, but what I mean to say is that if this boiler is properly designed most boiler troubles will disappear. Flat places should be carefully sought out, and there should be no staying between the backhead and this outer crownsheet.

Of course there is no difference of opinion as to the superiority of the butt joint with inside and outside covering plates. The circular form is preserved best by it, and it gives the strongest joint. In case an extra strong joint is wanted,—and who does not desire it?—the inside plate can be extended beyond the outside and one or more rows of wide pitched rivets placed through it and the shell proper. In this case the inside plate should be as narrow as is consistent with the object in view, because any inside plate tends to straighten out between the rows of rivets and thus be ineffective in a measure. This plate should be as thick as the shell in order to minimize such a tendency, but it should be pointed out that this tendency would not exist if the inside plate could be calked, and thus the steam prevented from getting between it and the shell. The calking cannot be done, however, unless the covering plate is very thick and scalloped around the rivets. When a joint is made in this way, and it is not uncommon in foreign marine works, the narrow plate is placed inside and the wide scalloped plate outside. This makes the strongest possible joint and probably has an efficiency of nearly 95% of the solid plate.

While upon this point I wish to point out the deceptive nature of a joint that is frequently seen on locomotive boilers. I refer to the lap joint with an inside bent cover plate. I have watched the behavior of large sections of this joint in the Watertown testing machine and can testify to the all but uselessness of the welt. Its action is to straighten out and allow the main part of the joint to be ruined before it is pulled taut, at which time, of course, its own elastic limit is passed at the bend. Such a welt should always be thick and the rivets nearest the bend should be as close as possible to it.

Concerning tubes, many people believe that long tubes are objectionable. But it should be remembered that the smokebox temperatures of our locomotives are between 600° and 1,200°, while the temperature of the steam is not usually much above 300°. We either want longer tubes or more tubes of the present length. In other words, in the usual type of bituminous coal burning locomotives, the heating surface should be more than 73 times the grate surface, which is the common ratio. In France this matter of tube lengths has received much attention, and tubes 16 ft. long have been used for years.

In conclusion I wish to call attention to the device of a Frenchman for increasing the heat absorbing surface of tubes—the Serve tube which has longitudinal internal rib, thus increasing the inside surface some 90%. These ribs not only possess more surface, but the ribs slice up the gases and abstract the heat from the center. It seems to me that this provides a most promising means of cooling down the gases in locomotive boilers. Tests have shown an increase of evaporation per pound of coal of some 10% to 15%.

The elevation of railway tracks in Chicago continues to be agitated, and the Council has passed an order calling for an estimate of the cost of elevating the tracks of the Chicago & Northwestern Ry. from Noble St. to Fullerton Ave. Further particulars on this subject, referring to the elevation of the Chicago, Burlington & Quincy Ry. tracks, and the elevated terminal system of the Chicago Elevated Terminal Ry. Co., were given in our issue of Dec. 19, 1891.

The "cylindrical steel car," which many of our readers have doubtless seen in its tours about the country, is now reposing at the New York & New England station in Boston. Its inventor, Chas. M. Smith, No. 1 Beacon St., Boston, advertises in a Boston financial paper that $200,000 has been raised to establish works for the manufacture of these cars, and $40,000 more is required "to meet expenses while preparations for manufacture are being made." Some of the Southern "boom towns" have here a fine chance to draw a car building works to their site—provided they can "make a raise" of $40,000.

A proposition to furnish electrical power for the pumping station in connection with the new water supply of Spokane Falls, Wash., has been made to the city by the Edison Electric Illuminating Co. through its manager, Mr. W. S. Norman. The company offers to deliver electrical power to a pumping plant located anywhere within a radius of three miles of the city on the following terms: Pumping plant to be run throughout the 24 hours, water being pumped to a reservoir between 12 p. m. and morning: First five years, $6,000 per year; second, $10,000; third, $12,000; fourth five years, $15,000 per year, sufficient power always being furnished to drive the plant necessary for the city's need. Or the company offer to deliver electricity to the motor pumps and lift all water required at the rate of five dollars per million gallons, as shown by the registered record of the pumps. If desired, the wires and the pumping station would be placed underground for an advance of 10% on the above price, or for $5.50 per million gallons. The lift for the proposed new supply is not given. At Pawtucket, R. I., where towns with a combined population of about the same as the population of Seattle are supplied with a lift of about 160 ft., the cost in 1890 was $6 per million gallons, raised 100 ft.

PERSONALS.

Mr. A. G. Darwin, President of the Strong Locomotive Co. and a director of the New York & Long Island Ry. Co., died recently at Glen Ridge, N. Y.

Mr. A. T. Dice has been appointed Superintendent of Signals on the Hudson River and Harlem divisions of the New York Central & Hudson River R. R.

Mr. George W. York has been elected Treasurer of the Maine Central R. R. Co., vice Mr. J. A. Linscott, resigned. Mr. William W. Colby has been elected Auditor.

Mr. William Smith, Superintendent of Motive Power of the Boston & Maine R. R., died in Boston, Mass., recently. He had been connected with the road since 1849.

Capt. Geo. C. Dickinson, M. Am. Soc. C. E., Chief Engineer of the Broadway & West Virginia Ry., died of pneumonia at his home in Cobham, Albemarle Co., Va., Jan. 24.

Mr. I. D. Barton has been appointed General Manager of the New York & New England R. R., and Mr. W. H. Blood succeeds him as General Superintendent of the Long Island R. R.

Mr. A. F. da Rocha, a graduate of the Rensselaer Polytechnic Institute, died in Santos, Brazil, on Dec. 8, 1891, of yellow fever. He was in charge of a survey for a sewerage system for the city.

Mr. James T. Furber, General Manager of the Boston & Maine R. R., died at Lawrence, Mass., Jan. 27. He began his railway career as a station agent on the Boston & Maine R. R. in 1856. In 1871 he was made General Freight Agent, and in 1873 General Superintendent of the road. He was largely instrumental in bringing about the consolidation of the Eastern and Boston & Maine railways.

Sir George Bedell Airy, Astronomer Royal, died at Greenwich, England, Jan. 2, aged 90 years. In 1846 he was a member of the royal commission appointed to report upon the railway gage question, that being the time of the struggle between the gages of 7 ft. and 4 ft. 8½ ins., known as the "battle of the gages." The commission reported in favor of the latter, which is now the standard gage. Sir George Airy was also engaged on the astronomical work in determining the boundary between the United States and Canada, and had been connected with many scientific investigations. He had been Astronomer Royal for the last 45 years, during which time he introduced many improvements in observations and records.

Wilson Bros. & Co., the engineers and architects of the Drexel Institute and many other prominent buildings in Philadelphia, are made the subject of an extended personal notice in the "Public Ledger" of that city. Mr. Joseph M. Wilson graduated from the Troy Polytechnic in 1858, and after studying analytical chemistry for several years became an assistant engineer on the Penna. R. R. in 1860. From 1863 to 1865 he was Resident Engineer on the middle division, and was then Principal Assistant Engineer on the main line in special charge of bridges. His title was afterward changed to Engineer of Bridges and Buildings and he continued in this office until 1886, when the present firm was founded. With Mr. Henry Pettit, Mr. J. M. Wilson designed the Main Building and Machinery Hall of the Centennial Exhibition of 1876. He is holding for the sixth time the presidency of the Franklin Institute of Philadelphia, and has been for years a member of the American Society of Civil Engineers and of the Institution of Civil Engineers. He was one of the experts appointed by the Government to investigate the Washington tunnel scandal, and was engaged in like capacity in the report on the proposed Broadway rapid transit road in New York.

Mr. John A. Wilson, the head of the firm, graduated from the Rensselaer Institute; was an assistant on the original Panama railway surveys; an Assistant Engineer on the Pennsylvania Railway, and in 1861 Chief Engineer of the Junction Ry., in Philadelphia. From 1861 to 1863 he was Chief Engineer of the Philadelphia & Erie Ry., and thereafter, until 1875, he was in charge of the maintenance of way of the main line. Mr. John A. Wilson is also a well known expert in railway cases.

The remaining members of this firm are Mr. Henry W. Wilson, civil engineer; Mr. Charles G. Darrach, hydraulic and electrical engineer; and Mr. Henry A. Macomb, architect. All are acknowledged experts in their special branches. Among the more prominent and later works of the firm finished and on hand are the following: The State Hospital for the Insane at Norristown, Pa.; the Presbyterian Hospital, the Drexel Building, and the Drexel Institute; the new station of the Philadelphia & Reading R. R., on Market St.; the Pennsylvania Institute for the Deaf and Dumb, at Mt. Airy; the new county prison, at Holmesburg, Pa., with many other structures for scientific and religious purposes.

NEW PUBLICATIONS.

THE MANUAL OF AMERICAN WATER-WORKS. Compiled from Special Returns; Containing the History, Distribution, Consumption, Revenue and Expenses, Cost, Debt and Sinking Fund, etc., etc., of the Water-Works of the United States and Canada; with Summaries for Each State and Group of States and Classification, by Size, of Towns Having Works. M. N. Baker, Ph. B., Editor. Third Annual Issue. New York: Engineering News Publishing Co. 8vo. pp. xliii + 384; nine diagrams; 13 tables; $3.00.

As with previous issues of the "Manual" we refrain from extended comment upon this one, since it is our own publication and has been prepared under the direction of one of the associate editors of this journal. The scope of the work is already well known to the majority of those our readers who are interested in publications relating to water-works engineering, finance and management, and is indicated in connection with the title. Some slight changes and some new features are included in the present volume, which, with other information regarding the book cannot, perhaps, better be set forth than by quoting from the preface, as follows:

This volume contains descriptions of all water-works known to be in operation or under construction July 1, 1891. In addition, brief descriptions are given of such projects as did fair to develop into works.

As the descriptive matter relating to old works has been printed in one or both of the previous editions of the "Manual" the greater part of it is omitted from this volume, which, so far as the main descriptive matter goes, should be used in connection with the issue for 1889-90. All changes and improvements to existing water-works made since the last issue, and all new works, are included in the present volume, the descriptions of new works being as complete as the information at hand would allow.

The figures under "Distribution" and "Financial" have been corrected to include the fiscal year 1890. All other information has been corrected and supplemented to as late a date as the compilation and press-work would permit, extending, in general, from July to November, 1891. The fiscal year 1890 includes all years closing between July 1, 1890, and June 30, 1891. The date upon which the several fiscal years close is stated whenever known, and figures are always for the fiscal year 1890 unless otherwise indicated. When so late figures could not be obtained the nearest available ones were generally substituted and their date stated.

In place of the matter mentioned above as omitted much statistical matter for previous years is given, thus presenting a means of comparing the yearly growth of the more important works. These figures are taken from a large and recently made collection of annual reports and from previous issues of the "Manual" and from the "Statistical Tables of American Water-Works," which was published by "Engineering News" for several years prior to the first issue of the "Manual," and of which the latter work is an outgrowth. The reduction in the size of the present volume is largely owing to more compact typography.

In addition to the above especial attention is called to the introduction of the present volume and to the list of cities arranged in order of populations, the last census populations being given. The above list is designed to aid those who may wish to make comparative studies of works in towns of certain sizes.

Besides reviewing the status of works, growth and prospects for new construction and improvements, the introduction treats at some length the practical subjects, "Consumption of Water and Use of Meters;" "Management of Public Water-Works and Tenure of Office of Governing Bodies," and "Franchises of Water Works Companies." In addition, the relative growth of public and private works since 1800 is considered in detail and graphically illustrated by diagrams. All the studies in the introduction are accompanied by tables showing actual status or actual practice in different states or in different sections of the country. For instance, for each state there is given, grouped in different tables: Number of works, miles of mains, number of taps, meters and hydrants, reported and estimated cost, population supplied both in 1890 and 1890, increase and increase per cent., increase due to growth of towns supplied in 1880 and increase due to introduction of water in towns not so supplied; works projected with fair prospects of construction; number of public and private works. Other information is summarized by groups of states and by the whole country, as number of works constructed to the end of each half-decade from 1801 to 1870 and from 1871 to 1890 and the partial year 1891.

In conclusion, this issue of the Manual brings down to

date, as nearly as possible, all information contained in previous issues; omits some matter already printed twice n order to present figures showing the growth of individual works and in order to keep the volume from becoming so bulky as to be unwieldy; and in its introduction aims to contribute somewhat to the solution of practical questions relating to the water supply of our cities and villages and to show the wonderfully rapid growth and present importance of this class of municipal works.

A MANUAL OF THE STEAM ENGINE. PART II. Design, construction and operation. For engineers and technical schools (advanced courses). By Robert H. Thurston, Director of Sibley College, Cornell University, etc. New York, John Wiley & Sons. 8vo., pp. 934. Many illustrations in text. $7.50.

The experience of the author and his past work in the discussion of steam engineering is a sufficient warrant for the practical character of this volume. In Part I., already published, Mr. Thurston exhaustively considered the theory of the subject, and in this volume he as fully and carefully treats of the practice of the design, construction and operation of steam engines. This is essentially a book for the engine builder, for the office of the workshop. It is idle to attempt to review its contents in our limited space, but it is sufficient to say that the whole subject is treated with the thoroughness and scientific and practical detail that one would expect from its well known author. Considered by chapter-heads alone, this work discusses the design of the steam engine; valves and valve motions; regulation, governor, fly-wheel, inertia effects; construction and erection; operation, care and management; engine and boiler trials; specifications and contracts, and cost and estimates.

THE TRACKMAN'S HELPER. A Pocket Companion for Track Foremen. Second edition, revised and enlarged. By J. Kindelan, Roadmaster, Mitchell, S. Dak. Published by the author. 12 mo., pp., 364, 28 illustrations, 28 tables, no index, $1.50.

We have already reviewed the first edition of this book in our issue of Aug 15, 1891. The new edition is very considerably enlarged (by about 100 pages), but retains the same general character and the same merits and demerits. The work is not intended for the guidance and instruction of engineers of maintenance of way, but for roadmasters, who demand simplicity of statement, and expressions of opinion rather than of arguments pro and con. For such it is well adapted, as the opinions expressed are in general in accordance with the best modern practice, unless we except the remarks on the comparative merits of even and broken joints, which betray a lack of experience with any other than even joints, and a lack of full comprehension of the advantages to be gained from broken joints. We are surprised also to miss from the volume any adequate information as to the various new spikes which have been introduced within the last few years, some of them of great merit and promise. An opinion which is of more than questionable soundness, moreover, is the unqualified assertion that "gravel and stone combined make a better ballast than either separately." But with these and a few other like exceptions, the work appears to inculcate good practice throughout, and it is written in that plain and simple style, which is most likely to make it acceptable and s rviceable to practical trackmen.

EARTHWORK SLIPS AND SUBSIDENCES UPON PUBLIC WORKS: Their Causes, Prevention and Reparation. Especially Written to Assist Those Engaged in the Construction or Maintenance of Railways, Docks, Canals, Roads, Water-Works, River Banks, Reclamation Embankments, Drainage Works, etc. By John Newman, Assoc. M. Inst. C. E., Author of "Notes on Concrete and Works in Concrete," "Iron Cylinder Bridge Piers," "Queer Scenes of Railway Life." E. & F. N. Spon, London and New York, 1890. Cloth, 8vo, pp. 234. Price, $3.

This book is by the author of "Scamping Tricks," which was reviewed in our issue of Sept. 5, 1891. It is of a practical character, giving the reasons for slips in various materials, and the methods of preventing them, or of making repairs and preventing further slips after they have once occurred. This subject is treated comprehensively, though in a somewhat discursive manner. The book is the result of some 25 years' experience on various works, and contains many notes of practical value gathered during this experience.

DAS EISENBAHN-GELEISE. Von A. Haarmann, Generaldirektor des Georgs-Marien-Bergwerks-und Hütteinverens. Leipsic; W. Engelmann. Two volumes, 8vo, pp. 1,000; 1,837 illustrations in text; $10.

The first volume of this work was published in September last, and the second volume is promised at an early date. The author is the director of the Osnabrück steel works, and he has investigated with much care and labor the history of railway superstructure from its first inception. The contents of this volume may be given as follows: (1) General history of railway track: Preliminary history of railway building; Evolution of rail sections: Wooden and stone ties; Iron ties; Fastenings on wooden, stone and iron ties; Disposition of joints; Splicing of joints; and Switches. (2) Special history of track; Separate wooden ties; Wooden longitudinals with plates, chair, bridge and flange or tee rails; Stone ties; Wooden ties; Iron ties, and iron longitudinals. (3) History of tracklaying; Gage; Profile (grades and curves); Roadbed (ballast and drainage); Maintenance of track. (4) Appendix: The materials of construction.

WHIPPLE'S ELECTRIC AND STREET RAILWAY FINANCIAL DIRECTORY.—Third year. New York: The Fred. H. Whipple Co.; 8vo., pp. 523.

This directory gives a list of the central electric light stations, of isolated electrical plants and of street railways—electric, cable and horse—in the United States, Canada, Mexico and Cuba. Under central electric light stations the owners and officials are given; authorized and paid-up capital stock; date of holding annual meetings; kind of dynamos, engines, boilers, belt and wires in use; capacity of station and number and kind of street and commercial lamps and miles of street circuit; price per street lamp, with candle power and hours lighted; date of expiration of contract; and finally a financial rating to be understood only by the use of a confidential key.

Under isolated plants the owners, and number of lights and system in use are given.

Under street railways name and officials of companies, capital stock, authorized and paid up, date of holding annual meeting and equipment of road are given.

As stated in our review of the second issue of this directory it is much to be regretted that no summaries are presented showing the number, at the very least, of the several classes of plants included. As it is, any one who wishes to know the number of central stations, for instance, in any state, or even in the United States, must count them for himself. A few hours work along this and other lines on the part of the compilers of the volume might save days, in the aggregate, for the users of the book and would greatly add to its value.

A MANUAL FOR VOLUNTEER OR PAID FIRE ORGANIZATIONS USING HAND OR STEAM FIRE ENGINES. By W. C. Lewis, Editor "Fireman's Journal;" 42th edition. New York; A. P. Ford, 95 Liberty St. 12mo, pamph., pp. 28; 15 cts.

This little pamphlet gives some facts regarding the causes and prevention of fires and full directions for the organization and operation of fire companies.

REPORT OF THE STATE BOARD OF HEALTH OF OHIO for 1890. C. O. Probst, Secretary. 8vo, pamph., pp. 387.

The report contains the usual information regarding the health and mortality of the state, the work of the board during the year, and reports from local health boards, together with a list of the latter. It also contains the proceedings of the National Conference of State Boards of Health held at Washington, D. C., in May, 1891, and a manual of the health laws of Ohio. In addition a short, descriptive history is given of the water-works of the state, reprinted from the "Manual of American Water-Works." The average annual death rate for an estimated population of 1,212,727, being the aggregate of the cities and towns reporting, was 17.855 per thousand of living population. Nearly 25% of these deaths resulted from zymotic diseases.

WHITAKER'S ALMANAC FOR 1892. Containing an Account of the Astronomical and other Phenomena; a Large Amount of Information respecting the Government, Finances, Population, Commerce and General Statistics of the British Empire throughout the World, with some notice of other countries, etc. By Joseph Whitaker, F. S. A., London, 12 Warwick Lane. 8 vo; pp. 728.

This almanac is a mine of information under the heads above given and is invaluable for the better understanding of the internal economy of the British Empire. In addition to the annual statistics usually given, this volume enlarges on matters of later interest in England and devotes considerable space to separate articles on educational progress, the progress and expansion of steam navigation, naval gunnery and the results of the last English census. Each one of these articles is a concise but full resumé of the subject treated. Under the head of "Our Present Ocean Mail" a sketch is given of each of the present great steamship lines to the Americas, Asia and Africa, with the names and net tonnage of ships and the speed records of the later and faster ones.

The complete process of taking the late census is given, together with the results and their relation to previous enumerations. The aggregate populations of the United Kingdom, in April, 1891, was 37,740,283, an increase of 2,835,435 on the census of 1881, or 8.2 % increase in 10 years. This percentage showed marked variations in the six preceding intercensal period. It declined from 15% in 1821-31, to 11.2 and 2.5% in 1831-41 and 1841-51 respectively; it then rose to 5.6 in 1851-61, to 8.8 in 1861-71 and 10.8% in 1871-81, and declined again to 8.2 in 1881-91, as above given. Considered separately for the last 10 years, the percentage of increase was 11.7 for England, 11.6 for Wales, 8.0 in Scotland, and Ireland showed a decline of 9.1%. The population of England and Wales at midnight on April 5, 1891, was 29,001,018; Scotland had a population of 4,033,103, and Ireland had 4,706,162 inhabitants, a decrease of 468,674 persons since 1881.

ANNUAL REPORTS OF THE CITY OF COLUMBUS, O., for the year ending March 30, 1891. Josiah Kinnear, City Civil Engineer; A. H. McAlpine, Superintendent Water-Works. 8vo., pp. 521.

The reports of the city engineer and superintendent of water-works give valuable statistical matter. Pumping statistics are given in detail, one table showing the monthly and total outputs of water pumped for fire protection during the year. The total for the year was 27,221,000 gallons, or about 1.1% of the total pumpage. There were 235 fire alarms during the year and fire pressure was maintained for 81 h. 37 min. The average amount of water pumped for each fire alarm was about 115,009 gallons, but, of course, there were some alarms with no pumpage, or practically none.

The report also contains a very detailed exhibit of the annual amounts expended on the water-works sor construction and current expenses for the past 20 years.

REPORT OF THE STATE BOARD OF HEALTH OF MASSACHUSETTS. S. W. Abbott, Secretary; F. P. Stearns, Chief Engineer. 8vo. pp. 588; folding map, plate and diagrams.

This report reviews the work of the board for the year ending Sept. 30, 1890. The section on the examination of water supplies and rivers, however, covers a year and a half, from June 1, 1889, to Dec. 31, 1890. The chemical and biological examinations under this head continue the tabulation given in Part I. of a special report on Water Supply and Sewerage, published in 1890, extending from June, 1887, to June, 1889. This special report was reviewed in Engineering News for May 30, 1891.

"Suggestions as to the selection of Sources of Water-Supply," which occupies about 40 pages of the present volume, was abstracted quite fully in our issue of Nov. 7, 1891. Some of the facts and conclusions from "Typhoid Fever in Its Relation to Water Supplies" were given in Engineering News for Nov. 14, 1891.

The work done at the Lawrence Experiment Station in 1890 in a study of the filtration of water and sewerage is reviewed in the report under consideration.

The work done at the station in 1888 and 1889 and much information on the above named subject was set forth in Part II. of the special report on water supply and sewerage, abstracted at length in our issue of July 11, 1891. In connection with the above study about 2,000 samples of sewage, water and sand were examined at the experiment station in the fiscal year 1890.

In addition to the matter already referred to this volume contains reports upon the inspection of milk, food and drugs; a summary of weekly mortality reports; a digest of reports on the health of towns; a study of the growth of children in accordance with Galton's Method of Percentile Grades; and, it may be added, a very good index.

REPORT ON THE TRANSPORTATION OF PASSENGERS IN AND AROUND THE CITIES OF EUROPE. Made by Osborne Howes, Jr., to the Rapid Transit Commissioner of the State of Massachusetts and the city of Boston. Nov. 10, 1891. Pamph., 8vo. pp. 68.

REPORT ON THE TRANSPORTATION OF PASSENGERS IN AND AROUND THE CITIES OF EUROPE. Made by John E. Fitzgerald to the Rapid Transit Commissioner of the State of Massachusetts and the city of Boston. Oct, 16, 1891. Pamph., 8vo. pp. 56. Map of Metropolitan Railway and sectional views of the Mersey Railway.

We have so fully abstracted these very elaborate reports in late issues that no further notice is necessary here.

TRADE PUBLICATIONS.

THE LAWRENCE CEMENT CO. Calendar for 1892.

The Lawrence Cement Co., of New York, has issued a very handsome business calendar, one of the best that has come to our notice. The picture of a magnificent mastiff is reproduced in line engraving, representing the "strongest of the strong" as an emblem of the company's "Hoffman" brand of cement.

ASHTON VALVE CO. Calendar for 1892.

The Ashton Valve Co. publishes this year one of the handsomest calendars which reaches our table, not gaudy, and with the advertising feature kept in the background, but extremely well designed and printed. A novel feature which we wonder is not more often imitated is that the lunations of the moon are given on each monthly tablet, as they very well can be.

ENGINES.—J. S. Mundy, Newark, N. J. Paper; pp. 32; illustrated.

Catalogue of friction drum hoisting and winding engines for different kinds of work, dredging machine, pile drivers and description of the Mundy patent friction drum.

THE TRACK SPIKE, THE TIE, THE SPLICE BAR. Morris Sellers & Co., Chicago, Ill. Cloth, 12mo, pp. 35; illustrated.

This pamphlet is mainly descriptive of the Greer spike, which is a flat spike with smooth surfaces, sharp corners and ground chisel edge. Several tables of tests are given showing the comparative holding power of Greer, standard and English spikes, and their resistance to lateral pressure on the rail. The Samson splice bar (with increased thickness at the middle) is also illustrated, and a list of roads and sales given showing 10,186,999 bars manufactured up to Oct. 1, 1891.

GRAPHITE PRODUCTIONS.—Illustrated catalogue of the Jos. Dixon Crucible Co., Jersey City, N. J. Paper; 8vo.; pp. 40.

This is a catalogue and price list of all the company's varied manufactures, including lubricators, paints, pencils, etc.

CATALOGUE OF THE WEIR FROG CO., Cincinnati, O. 1892. Cloth, 8vo.; pp. 100. Many illustrations.

This catalogue contains illustrations and descriptions of frogs, street and railway crossings, switches, switch stands, bridge guards, rail braces, signals, and other track equipment. There are also rules for laying turnouts, tables of turnouts, bills of ties for turnouts, quantities of

material per mile of track, table of middle ordinates for curving rails, etc. The catalogue is well got up and well printed, and the illustrations are clear and distinct.

SOCIETY PROCEEDINGS.

RENSSELAER POLYTECHNIC INSTITUTE.—A reunion of the alumni will be held at Cleveland, O., Feb. 2 and 3. There will be excursions to engineering works and manufacturing establishments, an alumni meeting and a banquet. Non-graduates are invited. Headquarters at the Hollenden House. Clarence M. Barber is Secretary of the local committee.

SOUTHERN SOCIETY OF CIVIL ENGINEERS.—At the annual meeting held at Jacksonville, Fla., Jan. 19, two papers were read and discussed: "Railway Location," by Mr. Lynch, of Fort Worth, Tex., and "Highways," by J. E. Bozeman. The officers were re-elected: President, J. E. Bozeman, Selma, Ala.; Secretary, J. de Bruyn Kops, Savannah, Ga. The committee on legislation presented a proposed bill for the appointment of deputy state engineers.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—The twelfth annual meeting was held in Pittsburg, Pa., Jan. 19, Mr. T. P. Roberts, President, in the chair. The secretary's report showed a membership of 370. The following papers had been read during the year: "Slow Combustion Construction of Buildings," H. B. Chess; "Bridge Designs," H. J. Lewis; "Steam Economy in Rolling Mill Engine Practice," D. Ashworth; "Hydraulic Cements," A. E. Hunt; "Bridge Details," E. Swenson. The following officers were elected for the ensuing year: President, Alfred E. Hunt; Vice-Presidents, Phineas Barnes, Charles Davis; Secretary, R. N. Clark; Treasurer, A. E. Frost.

OHIO SOCIETY OF SURVEYORS AND CIVIL ENGINEERS.—At the annual meeting, at Columbus, O., the proposed bill for licensing surveyors (Eng. News, Jan. 9, and elsewhere in this issue) was discussed at length, amended and put into shape for presentation to the Legislature, a committee being appointed for this purpose. Owing to lack of time many, of the papers were read by title and passed for publication. There was an interesting talk by Prof. A. A. Graham, of Columbus, on the western and northwestern boundaries of the state. A committee was appointed to report at the next meeting on a plan for engaging a secretary to devote his entire time to the interests of the society and to the collection and care of a library, etc. The following officers were elected: President, C. H. Burgess, of Cleveland; Vice-President, L. W. Mathewson, of Cincinnati; Secretary and Treasurer, C. A. Judson, of Sandusky.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the regular meeting, Jan. 12, Prof. John N. Stockwell read a paper on "The Center of All the Dry Land on the Earth's Surface." He described the increasing wants of man as he advances in civilization, and noted some of the struggles that have taken place in his efforts to establish systems of weights and measures, and the most noted of all has been that to introduce the metric system. Its opponents have made most elaborate researches to establish the antiquity of our duodecimal system, and have even claimed it as of divine origin. In their investigations they have made a most thorough explanation of the Great Pyramid, and here they have found an abundance of what they regard as conclusive proof of the truth of their position. What they regarded as one of their remarkable discoveries was that this Great Pyramid was situated at the center of all the dry land on the earth's surface. It is true that the parallel of latitude which passes through this pyramid crosses more land than any other parallels, also that the meridian through it likewise crosses more land than any other meridian, but it is not true that the hemisphere which has this pyramid for its pole contains more land and less water than any other. In fact, there are several places which are the centers of more land than this pyramid. The true center of all the dry land on the earth's suface is situated about 1,800 miles from this pyramid, and a little north of east.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Jan. 2 Mr. Edward Flad read a paper on "An Inclined Cable Railway for Transferring Freight Cars Between the Upper and Lower Yards of the Western Cable Ry. Co." He described the construction and operation of a cable road built for transferring cars between the tracks of the Iron Mountain Ry. and Lemp's brewery. The grade of Potomac St., along which the road is built, is such that it is impracticable to operate with a locomotive, hence the cable system was adopted. Two loaded freight cars are transferred at each trip over a maximum grade of 7.2%. This is the first road of the kind. A number of novel features are introduced. There is a safety stop device, by means of which a train weighing 180,000 lbs. moving down grade at the rate of 5 ft. per sec. can be stopped within a distance of 5 ft. without any serious shock, a hydraulic cushion being provided to take up the energy of the moving loads. Electric signals are transmitted between the train and hoisting engine through an electric wire placed in the core of the steel cable.

Mr. Whitfield Farnham then gave a full account of the recent disastrous colliery explosion at McAlister, I. T., in mine 11 of the Osage Coal & Mining Co. The mine is well equipped, having duplicate pumps, steam and electric, duplicate fans situated at considerable distance from hoisting shaft; an electric plant for pumping and lighting, with the engines and boilers, is housed in substantial stone buildings. Two separate openings or escapement shafts besides the air shaft are provided, and are in daily use. The main shaft is 475 ft. deep. The explosion was started at 5:04 p. m., by a blow out of a "windy" shot or blast fired contrary to rules before the miners had been hoisted out of the mine. Gas or fire-damp was not a factor in the explosion, and powder played no part except as fired in the fatal shots in blasting down the coal. Coal dust seems the only remaining medium capable of carrying the explosion over the 2,000 ft. or more of entries which were affected by the accident. The work of rescue was prompt and effective, but 37 men were brought up dead, and 20 more died in the 12 days following, while about 120 were more or less injured, principally by burns.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the annual meeting in Pittsburg Jan. 19, Mr. John A. Brashear said he had completed an instrument to be used as the standard meter of weights and measures. The one now in use by the international bureau of weights and measurements has been declared to be in error, and it was very desirable to have an instrument that could be relied upon. An American physicist proposed as a basis of measurement a wave of light, which is of absolutely constant length, and will remain so as long as the solar system remains in the luminiferous ether. The difficulty was in first determining the value of a standard wave length, and then applying this method to the determination of the value of meter in terms of light waves. The theory of the method was fully worked out by Prof. Albert A. Michelson, whose measurement of the velocity of light is now recognized as the most accurate of all the determinations yet made.

The next step was to get the optical parts of the apparatus, as well as the mechanical devices, made. Prof. Michelson tried in vain to have it made in Europe. A year ago he applied to Mr. Brashear to undertake the task, the requirements being such that an error of one millionth part of an inch was the limit allowed. The instrument was completed and has been tested so thoroughly and so satisfactorily that Prof. Michelson is said to have stated that the accuracy of the optical surfaces was greater than he demanded.

The following are the officers elected for the ensuing year: President, Alfred E. Hunt; Vice-President, Phineas Barnes and Charles Davis; Secretary, R. N. Clark; Treasurer, A. E. Frost.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—On Jan. 21, the second day of the annual meeting, there was a pleasant excursion by steamer. The party proceeded first to Weehawken to examine the new hydraulic elevators for raising passengers to the top of an iron viaduct 875 ft. long, which runs back to the high grounds of the Palisades and forms the terminus of a line of the North Hudson County Ry. Co. The purpose of the company in building the viaduct and elevators is to develop the district along the summit of the Palisades by making it readily accessible from New York. The works were described and illustrated in Engineering News, Jan. 17, 1891. Mr. Charles W. Brush is Chief Engineer, Mr. Thomas E. Brown, Jr., Consulting Engineer, and Mr. George H. Blakeley, engineer for the contractors. The viaduct was built by the Passaic Rolling Mill Co., of Paterson, N. J., and the elevators and plant by the Otis Elevator Co., of Yonkers, N. Y. The party then visited the reservoir and high service tower of the Hackensack Water Co., of which Mr. Charles B. Brush is Chief Engineer. This tower was described and illustrated in Engineering News, Nov. 6, 1886. The party then returned to the steamer and proceeded to the Brooklyn Navy Yard, lunch being served during the trip. Among the points of interest at the navy yard were the armored cruisers "Maine" and "Cincinnati" (the latter not yet launched), some monitors, including the large double turret armored monitor "Miantonomoh," the dynamite gun boat "Vesuvius," the ordnance shops, and the machine and boiler shops, in which work is in progress on boilers and triple expansion engines for the armored cruisers "Cincinnati" and "Raleigh." There were also the old stone dry dock and new timber dry dock (Eng. News, May 10, 1890, and the concrete and the stone quay wall now in course of construction. The steamer then conveyed the party back to New York.

In the evening there was a reception and supper, and after the supper a few brief speeches were made which were very well received.

NORTHWEST RAILROAD CLUB.—At the meeting on Dec. 22 the subject discussed was the cause of cracks in firebox sheets, Mr. J. O. Pattee described experiments made by him to determine the cause of steel sheets breaking when being flanged. The first experiments proved conclusively the susceptibility of steel to injury when worked at a blue heat. The second experiments were made on six pieces, each 12 × 2 ins., cut from a steel plate. Two of these were heated to a cherry red 20 times, and were cooled each time in cold water. Each piece was then found to have shrunk $\frac{1}{16}$ in. from its original length. The metal was tested and found to be as ductile and homogeneous as before heating. A third piece was heated 20 times to a black heat and cooled by being half submerged flatwise in water. The contraction was $\frac{1}{16}$ in. Of the other pieces tested, No. 4 was heated 6 times and cooled on the ground. Its contraction was $\frac{1}{16}$. No. 5 was heated 20 times and cooled in the air. Its contraction was $\frac{1}{16}$ in. It was concluded from these experiments that washing out with cold water was bad for the boiler, and warm water was alone used for this purpose. Many cracks of sheets occur just after the hammering up of staybolts, which is generally done with the boiler at a heat where it is most susceptible to injury. Cleaning fires out doors and allowing a current of cold air to circulate through the firebox after the fire is drawn are things to be avoided.

Mr. W. H. Lewis attributed the surface abrasions of sidesheets to the difference in temperature between the outside and inside of the sheet, resulting in local bending strains. Both sheets and staybolts absorb carbon in service, and after a time soft wrought iron will become steel. Protecting the boiler from sudden changes of temperature when in the roundhouse is all right, but this is a small matter compared with the extremes of temperature which the firebox experiences in service, particularly on hilly lines. The heat in the firebox on long hard pulls may reach 2,500°, and when the engine stops at a water or coal station it may fall to 300°. To increase the water space in the leg, Mr. Lewis offsets the sidesheets between the second and third row of staybolts, and has by this plan more than doubled the life of his fireboxes.

Mr. McIntosh said that with Western coal the plan suggested by Mr. Seley (Eng. News, Dec. 19, 1891) of never dumping the fire and keeping it banked when the engine was not in service would not work well. If the locomotive could be kept out of service until the fire died out and was then dumped the plan might do; but few locomotives can be worked in this way.

Further discussion showed that cracks almost invariably start on the fire side of the sheet and generally at the staybolt holes, and staybolt breakages occur in the upper corners. There was general agreement that boilers should be washed out with warm water.

It was voted to invite supply men to be present at the meetings with the privilege of reading a paper on the topic before the club, provided that it be subject to the action of the club before being spread upon the records and that its presentation shall not occupy more than five minutes. At the meeting on Feb. 6 the subjects for discussion will be "Car Roofing" and "Boiler Inspection."

COMING TECHNICAL MEETINGS.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 1. Secy., C. L. Annan.

ENGINEERS' CLUB OF KANSAS CITY.
Feb. 1. Baird Building. Secy., H. Goldmark.

WESTERN SOCIETY OF ENGINEERS.
Feb. 3. Secy., J. W. Weston, 240 La Salle St., Chicago.

ENGINEERS' CLUB OF ST. LOUIS.
Feb. 3. Secy., Arthur Thacher, Odd Fellows' Building.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb. 3. Secy., F. Collingwood, 127 East 23d St., New York.

ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 4. Public Library Bldg. Secy., F. W. Cappelen.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Feb. 5. Secy., E. K. Smoot, 803 Commerce St.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 5. Secy., A. H. Porter, 50 Euclid Ave.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 5. Secy., O. von Geldern, 819 Market St., San Francisco.

SWEDISH ENGINEERS' CLUB.
Feb. 6. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.

ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 6. 1122 Girard St. Secy., J. C. Trautwine.

NORTHWEST RAILROAD CLUB.
Feb. 6. Union Station, St. Paul.

ATLANTA SOCIETY OF CIVIL ENGINEERS.
Feb. 9. Secy., Parker N. Black, Capitol Block.

NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 9. Occidental Block, Seattle. Secy., E. H. Warner.

ENGINEERING ASSOCIATION OF THE SOUTHWEST.
Feb. 11. Secy., O. H. Landreth, Nashville, Tenn.

TECHNICAL SOCIETY OF NEW YORK.
Feb. 11. 194 Third Ave. "Boiler Plant."

DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 11. Secy., Geo. H. Angell, Jacobson Block.

WESTERN RAILWAY CLUB.
Feb. 16. Rookery Building, Chicago. Secy., W. H. Marshall.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Feb. 16. Secy., J. H. Harlow, Pittsburg, Pa.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 17. Secy., S. E. Tinkham, City Hall.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 18. Secy., C. H. McLeod, Montreal, P. Q.

ENGINEERS' CLUB OF CINCINNATI.
Feb. 18. Secy., J. F. Wilson.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Feb. 18. Secy., T. G. Philfeldt, 113 Adams St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Feb. 18. At Atlanta, Ga. Secy., F. A. Charlot, Macon, Ga.

NEW YORK RAILROAD CLUB.
Feb. 18. Secy., H. G. Prout, 73 Broadway.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Feb. 19. Union Station, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 20. Secy., F. D. Jones, Helena.

NEW ENGLAND RAILROAD CLUB.
March 9. United States Hotel, Boston. Secy., F. M. Curtis.

CENTRAL RAILWAY CLUB OF BUFFALO.
March 24. Secy., Jas. Macbeth.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 16 to 20. San Francisco, Cal. Secy., F. R. Hutton, 12 W. 31st St., New York.

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AND

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GEO. H. FROST.....BUSINESS MANAGER

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The Engineering News "Manual of American Water-Works" for 1890-91 was published on Jan. 24, and copies of it can now be obtained at this office. Price, $3.00, postpaid. It contains the most recent financial, operating and technical information as to all American water-works, severally and collectively. A new feature of this issue is comparative returns for a large number of leading works extending over many years past. The introduction discusses the growth and future of American water-works, use of meters, franchises of water companies and other practical subjects.

Now that the little Chilian unpleasantness is over, is it not in order to remember that the most modest campaign in that country would have cost us $100,000,000, and that the mere loan of the government credit to that amount will insure the construction of the Nicaragua Canal at minimum cost, in the minimum time, with minimum tolls and under national control? It strikes us so. If Congress will only take that view of the matter, and be inspired by this unexpected windfall with a little liberality toward a peaceful enterprise, the Chilian difficulty will not have been in vain. We say nothing about the moral of that incident in respect to our need for a tolerable navy. That moral seems to have been drawn already, and naval appropriations seem likely to be reasonably liberal. But perhaps it is also in order to remember that if, a few years hence, we should happen to have some really serious national entanglement, our naval strength will then be about as great if we have in the meantime spent $100,000,000 on the canal and $100,000,000 on the navy, as if we had spent the whole $200,000,000 on the navy.

The editors of this journal have observed for many years past that, among the multitude of graduating theses submitted by engineering students which are of value and interest only as showing how the student has profited by his instruction, there are a few each year which have such special merit that they may fairly be regarded as contributions to engineering knowledge, either as records of original research, or as intelligent and concise discussions or critical summaries of older researches. For example, one of the best papers ever written on the locomotive engine as it was ten years ago, was written by a student as a graduating thesis, and was soon after buried alive in the pages of the "Journal of the Franklin Institute." We might mention others of more recent date which have been thus buried alive in other publications. A number of colleges maintain periodicals which are chiefly devoted to such mortuary uses, and it is well that they should. Great numbers of the better grade of college theses deserve publication in some form, but are yet not good enough to be classed as "live matter" for an engineering journal of general circulation among practicing engineers. But a few graduates each year, favored either by natural aptitude or special opportunity, produce papers of a much higher grade, such as any engineering society would accept with thanks for publication, and any engineering journal would gladly pay for. And it seems hard that the authors of such exceptional papers should have no way of obtaining credit therefor with the great body of the profession, at a time in life when any credit justly theirs is so especially important to them. There are but few such men each year, and the rest must take their chance; but to those few a recognition of the aptitude which they had shown for some particular line of work might make all the difference of an early and advantageous start in life or the loss thereof; for experience indicates that a goodly proportion of graduating engineers reveal by the subjects of their theses the natural bent of their minds which determines their subsequent career.

To give to the three or four men among four hundred who do such specially good work the credit which is due them, we concluded some weeks since to offer the premiums announced by the circular reprinted in another column, for the three best graduating theses of the current college year. We did this after consultation with a number of men, college professors and others, in whose judgment we felt confidence, and with one or two partial exceptions their judgment agreed with ours that the effect might be highly beneficial, both in stimulating the brighter men to do their best, in bringing to them the recognition which may be so useful to them, but which the colleges themselves cannot give to them, and in bringing to the knowledge of the profession some valuable papers which it would otherwise know nothing of. The offer of these premiums is only an experiment. This may prove to be a dry year, and no papers worth a premium may be offered. We call the especial attention of all concerned to the stipulation that no premiums will be awarded unless the absolute merit of the papers submitted seems to demand it. But we expect rather that our readers will be astonished at the quality of the material which this offer will bring forth.

A late memorial to the U. S. Senate, signed by all the more prominent practical working astronomers in this country not in the employ of the Government, calls for a needed reform in the administration of the new Naval Observatory, now building. It is pointed out that this observatory will be almost exclusively devoted to astronomical work, and the rating of ships' chronometers and the testing of nautical instruments is of very secondary import compared with the possibilities of its scientific plant and corps of observers. The great 26-in. telescope is of no use whatever, for example, except in astronomical research. It is justly claimed that the Superintendent or executive head of this Government observatory should be selected from among the ablest astronomers in the United States, and not from a list in which the only requisite for office is that the incumbent should be a Captain of the United States Navy, without special training or fitness for the office.

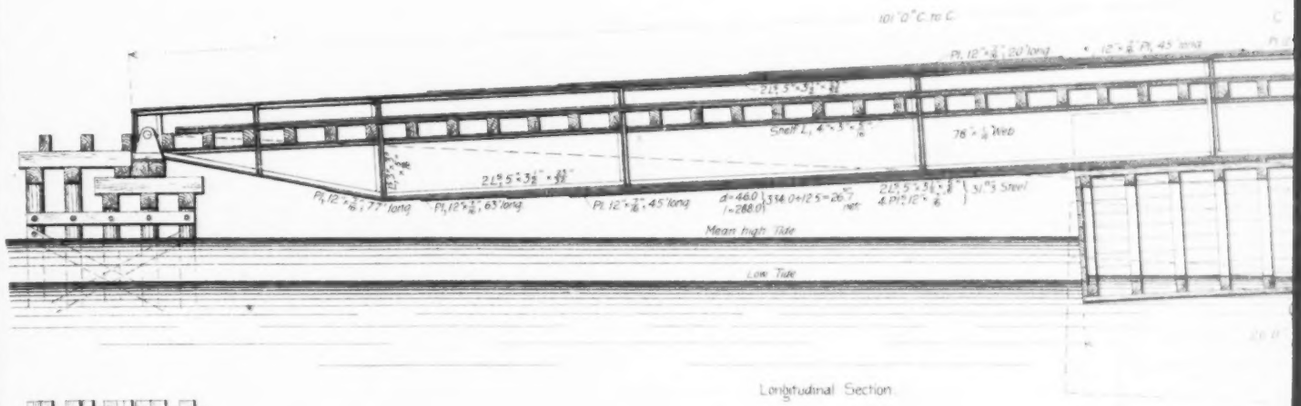
A well considered plan of work, pursued with zeal under a competent scientific head, is absolutely essential for success in investigation of this nature; and under any other system the liberal appropriations of the Government and the wealth of scientific apparatus on hand is worse than wasted. As the memorial states, a body of the ablest astronomers, thrown together without adequate guidance, without a problem to solve or concerted plan to work upon, can no more achieve success than an army can march and fight without a general. Astronomy is a science of such extent that none but those who have devoted their lives to its study can properly direct investigation or accomplish useful results. The present method of appointing the head of this scientific department is a survival of past practice and obsolete purpose, and, together with that of placing a line officer of the Navy at the head of the Bureau of Yards and Docks, should be abolished. Both of these departments require in their assistants scientific training of a very advanced order, for the proper conception and execution of the work intrusted to them; and the heads of these departments should certainly excel in the special branches over which they are placed, whether this is astronomy or civi engineering.

A novel factor with which the modern city engineer may have to deal in the near future and above all an especially flagrant case of the interference of municipal politics with the proper and economical performance of public work has come to our notice in a copy of the specifications for the construction of the proposed North Avenue Bridge at Baltimore, Md. From these specifications, which in other respects do not differ from those ordinarily used for such work, we quote the following paragraph:

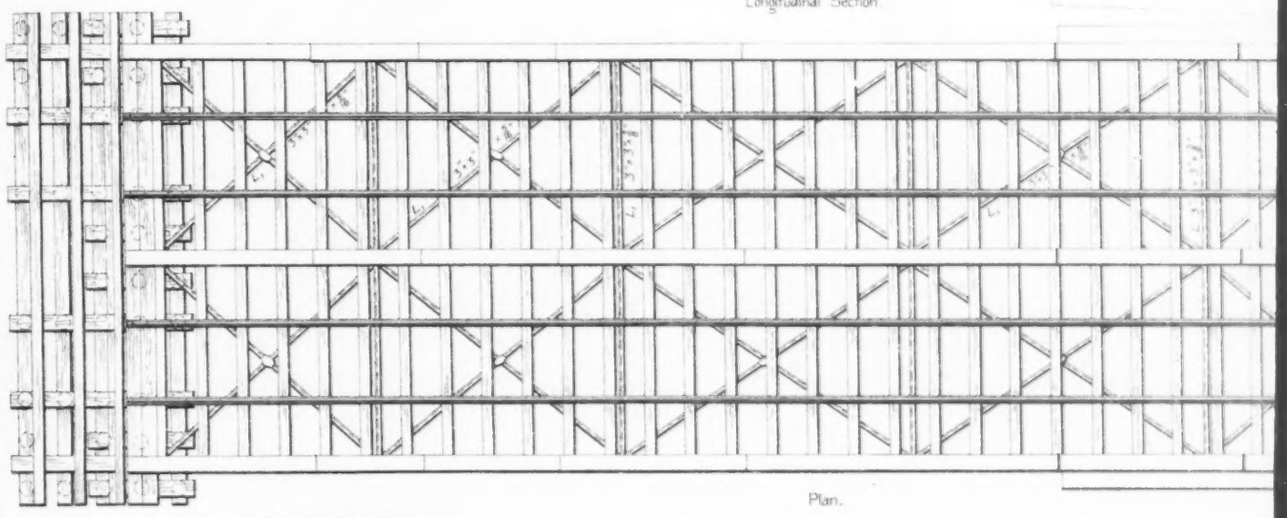
"Be it enacted and ordained by the Mayor and City Council of Baltimore, that the Mayor and heads of departments in the City Government shall have inserted in the specifications governing the construction of the bridge to be known as the North Avenue Bridge, as follows: That all stone work required in the construction of said bridge be dressed either in Baltimore or vicinity; that all artisans employed in the construction of the said North Avenue Bridge shall be members of *bona fide* labor organizations, provided an organization exists in the particular branch of industry in which such artisan shall be engaged. That if any person not a member of organized labor shall be employed by any contractor, the city official under whose supervision said work shall be done, upon being informed of such employment, shall notify said contractor of such employment, and upon the refusal of the contractor to discharge said persons so employed within 24 hours, the said contract shall be declared forfeited, and said contractor shall not receive any compensation for any work performed under said contract."

We have been unable to obtain the full history of the matter, but such details as we have obtained do not speak very highly for the honest purposes of the men whom the taxpayers of Baltimore have appointed to expend their money, or for the honesty and public spirit of the labor organizations, whose political power was used to further their own interests at the expense of the public. The bridge in question is of considerable magnitude and will involve the expenditure of a large sum of money. The first plans prepared were for a steel structure, but these were withdrawn, owing, it seems, to the pressure brought to bear on the city administration by the quarriers, carriers, stonecutters and masons through their various organizations, and plans for a stone bridge were substituted. Estimates based upon these plans and the statements of the stone men were prepared and bids for constructing the work were called for. The plans called for a bridge 480 ft. long and 100 ft. wide, consisting of three semi-elliptical arches of 132.8 ft. span each, supported by the necessary piers and abutments, the whole comprising about 24,153 cu. yds. of brick and stone masonry. Meanwhile the labor unions had secured the passage of the ordinance given above and under its protection had raised their prices so that upon the receipt of the bids the lowest was $95,000 more than the appropriation. The whole matter seems to have been an attempt of the labor unions to have the work done by day's labor by the city, as is the case with the streets and sewer work, with its increased opportunities for a "whack" at the city coffers, instead of by contractors.

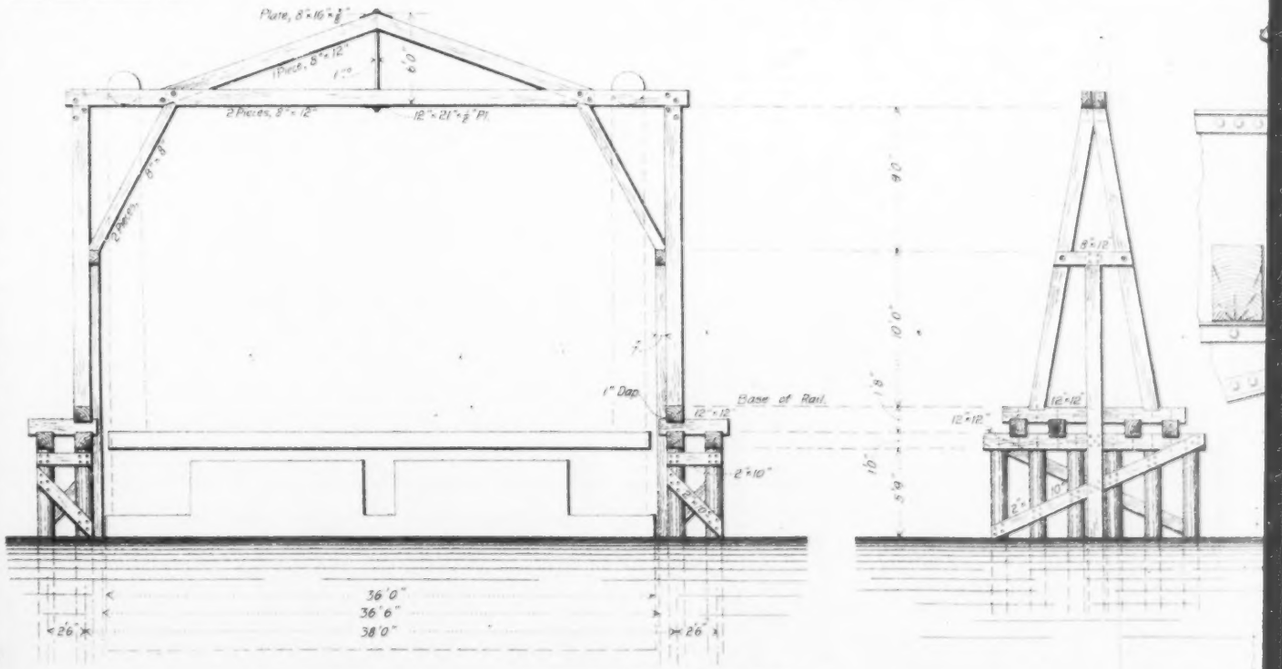
We have already noted the chief points touched upon in the Fifth Annual Report of the Interstate Commerce Commission, advance copies of which have been distributed to the press, but its interesting discussion of the topic of private ownership of cars deserves fuller notice. At the beginning of the railway era it was generally supposed that the railways would be public highways, on which any man would be at liberty to run his own vehicle as on the turnpike roads, paying toll to the railway company for the use of its road as he had before to the turnpike owners. The advent of the steam locomotive completely revolutionized this primitive conception of the railway, and for many years no cars were ever run except those owned by the railway companies. It is only within a few years that there has been a partial return to the original idea, large shippers of freight using their own cars and receiving from the railways a rental for the use of the car based upon the distance which it travels. The Interstate Commerce Commission is chiefly interested in the use of this private ownership of cars to secure for favored shippers special and unlawful privileges in the transportation of freight. The



Longitudinal Section.



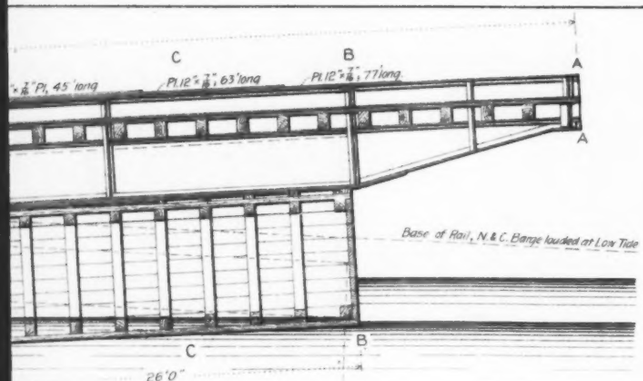
Plan.

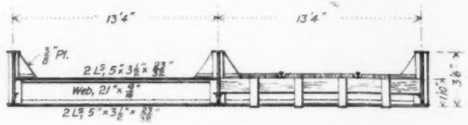


Arrangement of Piles and Gallows Frame.

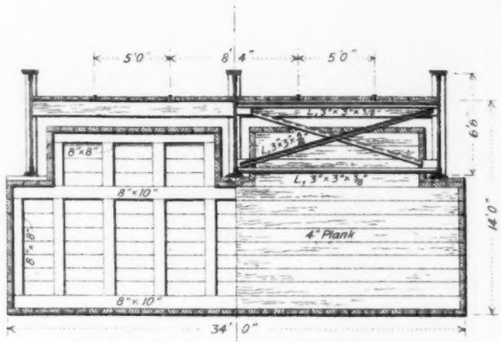
TRANSFER BRIDGE IN NORFOL

Chas. C. Wentworth, M. Am. Soc. C





Section A-A.



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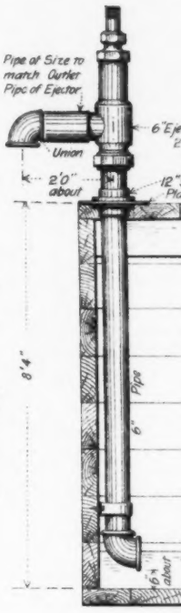
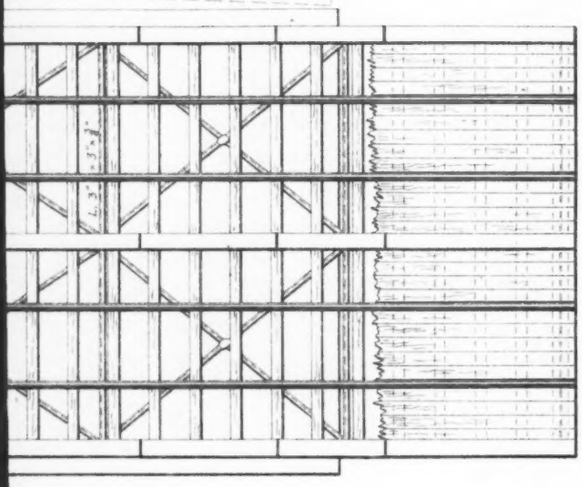
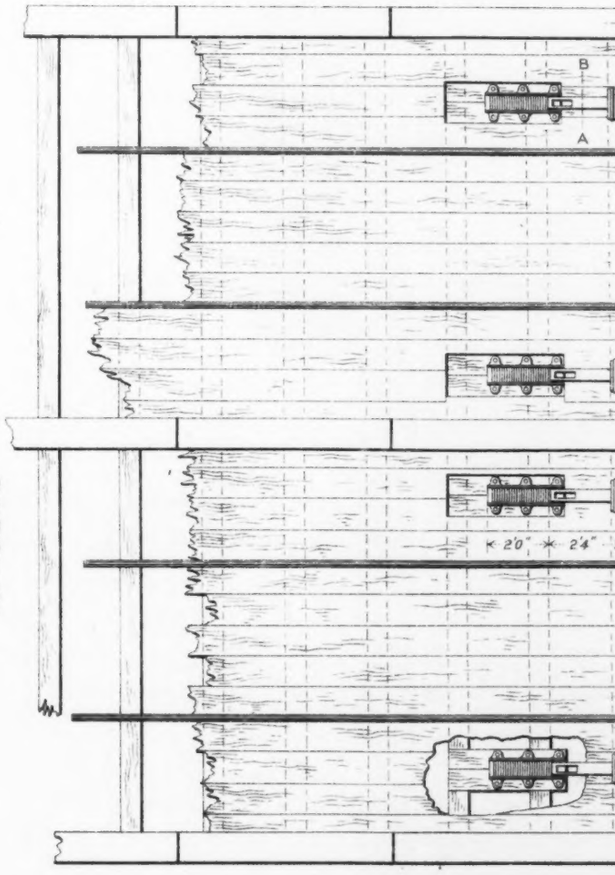
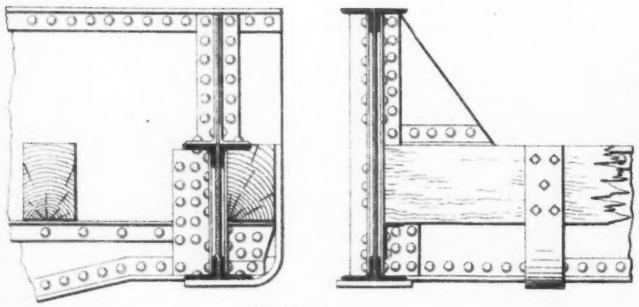






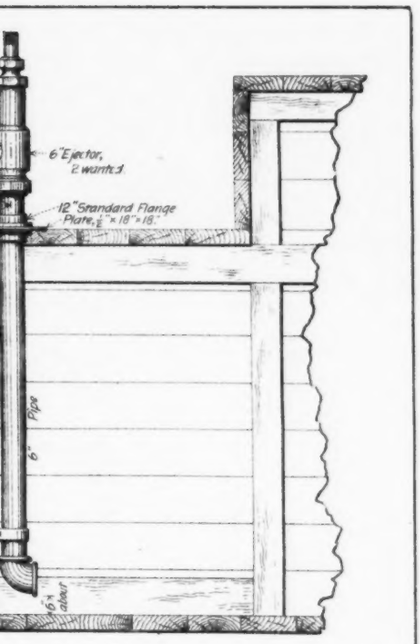


Detail at A.
(Main Girder.)

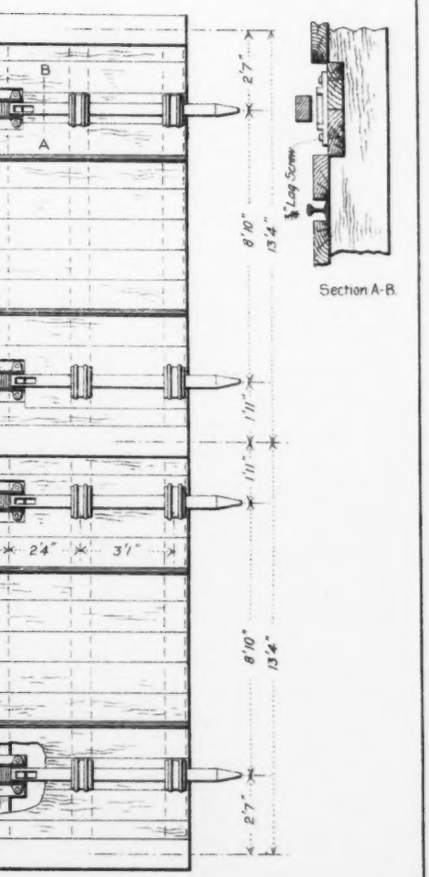
Device for Attaching Transfer Boat to Bridge.

N NORFOLK HARBOR FOR NORFOLK & CAROLINA RAILROAD.

h, M. Am. Soc. C. E., Engineer. American Bridge & Iron Co., Contractors



Ejector.



Section A-B.

ridge.

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regular mileage rate of ¾ ct. per mile, which is generally paid to private owners of cars, is in many cases sufficient to pay 25% or 50% annual profit on the original cost of the car. The Commission cites the Lackawanna Live Stock Express Co. as an example of a "wheel within a wheel" by which a large firm of cattle shippers secured special advantages in the shipment of stock over their competitors. The mileage paid on these cars in the first two years of service was more than enough to pay their original cost and all expenses of operating them.

Indeed the profit from the ownership of cars, direct or indirect, is such that large shippers of every class are securing their own cars. According to the "Official Equipment Guide," there were in July last about 350 private firms and individuals owning freight cars. The December number of that journal shows about 375, or an increase at the rate of 50 to 60 per year. Some of these companies control over a thousand cars, and the total freight now carried in cars owned by private parties is becoming no unimportant percentage of the total. This may be the better appreciated when it is remembered that the refrigerator cars, palace stock cars and special fast freight cars, which make up a large proportion of the privately owned rolling stock, run on through traffic, waste less time at either end of their route, and count up at least twice as much mileage in a year to their credit as that earned by the average box car owned by a railway company.

The Interstate Commerce Commission, without expressing a definite opinion, seems inclined to disfavor the private ownership of cars. Owners of railway stocks have sometimes expressed the same view, perhaps not without reason. It is true that the use of private car lines as a means of giving special rates to shippers and furnishing a fat investment to railway officers at the expense of the railway's revenue, is an evil. It is equally true that such private enterprises as the transportation of dressed beef in refrigerator cars, live animals in palace stock cars, and oil in tank cars have effected enormous improvements and economies. There is reason to believe that with the specialization in industries which is continually going on, the use of cars adapted to different sorts of traffic and owned by private companies is likely to increase. The benefits secured in the past warrant the expectation of similar ones in the future; and it is to be hoped that the Commission will use its influence toward removing the opportunities for abuses which now exist with the system, but will take no steps looking to its abolition.

THE INTERSTATE COMMERCE STATISTICAL REPORT.

In our last two issues we have given a very full abstract of the more salient facts embodied in this exceptionally important report, which marks the beginning of the first of a new era in our railway statistics, when we shall no longer have to rely on private enterprise for any essential facts. Much remains to be done to make these statistics what they should be, but it need only be remembered that, starting from nothing three years ago, the system of gathering and collating such a vast body of statistics has been brought to such perfection of detail as our abstract shows, to realize that the statistical work has been in able and faithful hands, which are likely to still carry it forward to all necessary perfection. The first annual report was quite imperfect, as was all but inevitable under the circumstances. The second was still defective, though an advance in many ways. The worst defect of both reports was that aggregates were given for the whole United States only. In the third and present report, not only has this defect been remedied by a subdivision of the United States into ten groups (as shown in the accompanying map, reproduced from our last issue), but the statistics have in many other ways been made more ample and complete, especially by the addition of ratios and percentages not previously given. Many of these changes are directly in the line of suggestions made by us in reviewing the last two reports, and some would appear to be the result of those suggestions.

Our abstracts already given showed with hardly any comment the main facts recorded in the report. We now propose to review some of the more significant of these facts, and also by way of suggestion, and not by way of complaint, to note what seem to be remediable defects of omission still remaining.

The statistician himself notes that there are three very regrettable omissions from his returns; in this we fully agree with him. These are (1) that express companies, though paying $20,277,711 yearly to railways (1.72% of their gross receipts), "have thus far successfully urged exemption from control by either state or federal government;" (2) that no records of water transportation in competition with railways are required, though the aggregate is vast in amount and intimately related to rational railway control; (3) that sleeping car and line car companies, and other companies and individuals leasing or furnishing rolling stock to railway companies, make no reports, nor do the railways for them. Unfortunate and unnecessary hiatuses thus exist in the statistics, as for instance on p. 39, where the commission is obliged to make the absurd report that only 535 sleeping cars are fitted with train brakes, against 162 dining cars. The explanation does not appear until p. 60, where it is learned that the sleepers owned by the Pullman and Wagner companies are not included. This might well appear in connection with these tables, as also a list of the total number in service of each of the 23 different classes of cars listed, which latter record, by the way, is not to be found anywhere in the report.* The statistics of automatic train brakes and couplers in use, however, are so old as to be robbed of much of the interest they would otherwise have, as already noted.

In addition to these desiderata, there are others which it is to be earnestly hoped will soon be included in the commission's reports. It is possible that for some of them additional authority might be needed, but we suspect not. The commission's authority for the collection of information bearing in any way upon the status or the proper regulation of interstate commerce is almost plenary under the existing law, so far as relates to corporations which are required to report to them all, which includes all railway companies.

As we have often noted heretofore, the most effective of all aids to a needed reform is the bare presentation of facts without comment, in such form that their meaning can be readily understood, and their authenticity cannot be questioned. The persuasive force of such mere statements of fact far exceeds the compelling force of mandatory legislation, for the reason that it is absolutely just and equal in its action. It might be said for them, in the words of a French author, "Je n'impose rien; je ne propose même rien; j'expose." "I impose nothing; I propose nothing; I merely expose." Their effect is merely to make each man who is shown to be a little behind his neighbors and equals anxious to be abreast with them, and each man who is already ahead of his neighbors anxious to keep so. In other words, as soon as any one road takes a decided step in advance, the moral pressure is great upon all the others to take the same step or show cause why they do not. Of other than moral pressure there is none.

The following among others seem to us to be subjects eminently deserving of treatment in the commission's annual statistical report, which are not now so included:

1. Accidents.—These should by all means be tabulated and reported by companies, and not simply by geographical groups, following in this respect the precedent already set by the English Board of Trade returns, which have proved so effective in reducing the number of accidents. For a graphical evidence of their effect see the diagram given in our issue of May 2, 1891, showing the decrease in British accidents to passengers in the past 17 years. It is not too much to say that the deaths per year show a tendency to become evanescent, except as some exceptional disaster like the Tay bridge may increase them for a single year. To prepare similar accident reports for our railways no additional returns are required.

2. Use of Interlocking Plant.—For this purpose, also, the commission have only to follow the Board of Trade precedents by simply presenting the facts without comment (and if need be with much less detail) to greatly promote public safety. No additional legislation is needed, any more than for the automatic brake and coupler work which the commission is so effectively doing, and only a few simple questions need be added to the existing forms. The number of main line switches and signals interlocked or not interlocked at the several junctions, terminals, large stations and small stations, with statement of the system at each, and of such partial and imperfect substitutes as hand worked semaphores, etc., would cover all that is required for the interlocking returns. The same is true of—

4. Block Signal Systems or Substitutes Therefor.—English experience has abundantly established that an annual detail statement of the progress made to date, and of the actual system in use on each line, branch or operating division, is enough to insure sufficiently rapid progress in this detail also. Lately the Board of Trade has been endowed with compulsory powers as to block signals and interlocking, but this was not until their use had become all but universal. For block signal returns the mileage on each operating division operated under each several system of absolute or permissive, automatic or non-automatic block, or by the train staff or other equivalent substitute, or by either of the various different train order systems, would alone be essential, though it would be highly desirable to add the total number of trains per year over each division.

Another addition, of a different nature, is desirable in the statistician's report, if in any way feasible. One of its most novel and valuable features is the record it gives of independent and subsidiary companies, distinguishing among the subsidiary lines those which are (1) controlled by corporate ownership of the entire capital stock (2) leased for a fixed sum of money, (3) leased for a percentage on earnings or some other consideration, or (4) operated under trackage rights in common with some other company. But, striking as is the exhibit of consolidated control which these relations alone cover there is another one of growing and great importance which they do not take cognizance of at all; that, namely, of control through common ownership of a majority of stock, without any formal corporate control. The Vanderbilt system is the chief example of such practical but informal consolidation, but we have made up almost at random, without any attempt at completeness, the subjoined list* of lines included under four such systems, and

* List of the lines which, according to common rumor and belief, are to a greater or less extent operated as one system through common ownership, without any formal corporate connection.

	Miles.
Vanderbilt System.	
Lake Shore & Michigan Southern Ry	1,409
Michigan Central R. R	1,608
Clev., Cinc., Chic. & St. L. Ry	1,797
Chesapeake & Ohio Ry	932
Chicago & Northwestern Ry	4,251
Chicago, St. P., Min. & Omaha Ry	1,389
N. Y., Chicago & St. Louis R. R	523
Pittsburg & Lake Erie R. R	164
Fremont, Elkhorn & Mo. Valley Ry	1,344
Total of controlled lines	12,920
New York Central & H. R. R. R	1,421
Total of Vanderbilt system	14,341
Gould System.	
Missouri, Kan. & Tex. Ry	1,774
Texas & Pacific Ry	1,498
International & Great Nor. Ry	825
St. Louis Southwestern Ry	1,222
Total of controlled lines	5,330
Missouri Pacific Ry	5,125
Total of Gould system	10,445
Mackay System.	
Peoria, Decatur & Evansville Ry	256
Louisville, Evansville & St. L. R. R	295
Evansville & Terre Haute R. R	180
Chicago & Eastern Ill. Ry	470
Total of Mackay system	1,201
Huntington System.	
Southern Pacific R. R. system	4,884
Newport News & Miss. Valley Co	538
Ky. & So. Atl. R. R	19
Total of Huntington system	5,441

This makes a grand total of 31,428 miles, which figures in the reports of the commission as operated by 22 different and independent corporations, but which is really controlled through common ownership of stock by four individuals or families. The gross earnings of these systems (taking the earnings of a few of the smaller lines from Poor's Manual, when not given in the advance sheets) were as follows:

Vanderbilt system	$135,698,149
Gould system	48,868,857
Huntington system	46,871,041
Mackay system	5,897,984
Total of the four systems	$237,360,731

This total is 22.6% of the gross earnings of all the railways of the United States, $1,051,877,632.

* It will perhaps appear in one of the seven statistical tables (occupying some 700 pages) not included in the advance copies, but there is no assurance to that effect.

the end is not yet. It will be seen that railways earning very nearly one-quarter (22.6 per cent.) of the total railway earnings of the United States, or no less than $237,300,731 yearly, are in reality controlled by four men or families, though in the statistician's report these figure as 22 wholly independent companies.

It is admittedly difficult to take official cognizance of such control through common ownership, but it is not therefore impossible; and so tremendous a fact cannot be ignored without vitiating all conclusions from the statistics of formal consolidations and deceiving the uninformed public as to the actual situation. The difficulty of bringing this informal kind of centralization within official cognizance, therefore, should be overcome in some way. It is not for us to suggest how, but the difficulty would not seem to be insuperable.

Chiefly because of this unrecognized but effective form of consolidation the interesting table on pp. 22-29, which purports to give figures for 75 different independent companies (all those having over $3,000,000 per year gross earnings), really includes only 48 different independent companies, or thereabouts, the remaining 27 companies being indirectly subordinate to others in the list or to the owners of those others. Making this change, and remembering also the figures given in the preceding footnote, the following amended quotation certainly makes a striking showing:

The length of line operated by the 75 [really only 48] companies in the above summary is 102,306 miles, or 65.41% of total mileage. The gross revenue is $846,888,000, out of a total gross revenue for the railways of the country of $1,051,877,632; that is to say, the corporations above named received 80.51% of the total amount paid by the people of the United States for railway service. The average revenue per mile of line is $6,725, while for the roads in question it is $8,278. The roads mentioned above performed 83.56% of the total passenger service and 85.38% of the total freight service resulting from the operations of railways in the United States during the year 1890, as is seen from the fact that out of a total of 11,847,785,617 passengers carried one mile, these roads carried 9,900,028,518, and out of a total of 76,207,047,298 tons carried one mile by all the railways, the railways in question carried 65,069,501,936. No figures could more perfectly indicate the concentration of the railway business in the United States, as well as the great diversity of conditions under which it is carried on.

It is but a short step from such consolidation as these figures show to the consolidation of our entire railway mileage into a dozen or less great systems, or even into one great system; and a step involving no serious change in the methods of managing the larger existing systems.

Inasmuch as the outlines of the railway groups do not even conform to state lines, and still less to the census groupings used for all other than rail, way purposes, it would be a very desirable addition to the next issue of this report if the population of each of the ten railway groups were given for at least three decades back, and a kind of official estimate given of the probable population of each group for some years ahead. It would then be possible to determine for each group the average payments per head to railways for passenger and freight service, the average use of the railways for transportation, the percentage of the total population engaged in transportation service, etc., etc. Such records are valuable and instructive in many ways, and could be given for the most part in a single table, requiring little additional space or labor in computation.

Especially is this true if the office were to adopt some better and quicker method than numerical computation for deducing its percentages and ratios. The statistician notes that "the number of percentages alone, which are computed to four places of decimals, exceeds 20,000," which involves great labor; but the same percentages can be obtained from the Thacher calculating instrument with a small fraction of the labor, or, perhaps still better, from a specially constructed slide rule about 10 ft. long, designed for this special work.

An interesting table giving information never before accessible is that on p. 16 showing by groups the mileage of double, triple, quadruple and side-track mileage. For the whole United States these figures for mileage reported (not total in existence) compare with last year's figures as follows:

June 30.	Single track.	Second track.	Third track.	Fourth track.	Side track.	Total track.
1889....	149,949	8,045	722	531	31,715	191,001
1890....	156,404	8,438	761	502	33,711	199,876

There was 4,325 miles of "unofficial" or unreported mileage in 1890, and 7,810 miles in 1889, which is not included in the above figures. It is probable, however, that this unreported mileage included a very small mileage of heavy traffic lines, in which double or triple tracks are used; and it would therefore appear from the above table that 393 miles of double track, 41 miles of triple track, and 31 miles of quadruple track was added to our railway system in the

Subdivisions of the United States Adopted by the Interstate Commerce Commission's Statistician.

year 1889-90. Group IX. (Texas) only has no double track, and Groups IX., V. and VII. only, so little as 25 miles. The proportion of sidings in percentages of miles of road we compute to be as follows in the several groups:

Group.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	U.S.
P.c. sidings	32.3	43.6	29.6	12.9	13.6	19.9	14.9	14 7	11.7	13.7	21.9
Freight ton-miles per mile road, '000 omitted	383	1,348	794	331	305	376	270	244	246	192	487

It will be seen at a glance that the percentage of sidings varies in tolerably exact ratio with the density of traffic.

A very interesting table (p. 31 of the report) showing how greatly economy of operation is affected by density of traffic was in part abstracted in our issue of Jan. 9. Such information has never before been available. It appears that in the New England states 1,852,677 passenger miles are made per passenger locomotive, whereas in the Texas group only a fraction more than half of this is made, the average for the whole United States being 1,413,142. In the Pacific group (X.) a still larger passenger mileage is made per locomotive (2,247,791) because of the very long average haul, but the number of passengers carried is not much more than half that in the New England states.

On the other hand, in efficiency of freight locomotives the New England States stand low, each locomotive handling only 3½ million ton miles, against 5⅚ million in the Middle states and 6 millions in the North Central states. The efficiency of passenger cars is extremely variable, but in no part of the United States does the efficiency vary very radically from the average of 1,529 cars for each 1,000,000 tons handled. In the far West, where hauls are very long, about 2,000 cars are required for this service.

We have already sufficiently reviewed the automatic brake and coupler records, which have the grave defects of being mere ancient history. We will only note in addition that the Safford is not in any sense an automatic coupler, nor does it deserve to be included in a list of them. It is only a special form of the old link "bull nose," claimed to be a little less likely to catch the hand in coupling, because the metal is cut away at the side, but otherwise identical with it.

Some notes which we desire to make in regard to the accident records, employees and their efficiency and a few other matters we postpone to a later issue.

A steam motor for street railways has been imported from Belgium by President Yerkes of the North Chicago Street Ry. Co. It is a double cylinder condensing locomotive entirely inclosed in a steel cab like the ordinary steam motor or dummy. The engine is 12 ft. long, 8 ft wide, 9 ft. high and weighs 7 tons. It is carried on four wheels 31 ins. diameter. It will be tried on some of the suburban lines.

A railway to Bagdad is being surveyed by English engineers as an extension to the present Ismidt-Angora line. "Indian Engineering" says that the project is revived for extending the Ottoman railway through Persia to connect with the Indian railway system. One spur of this line, 130 miles long, has already reached Anatolia, and an Anatolia-Bagdad line would be an extension in the proper direction.

LETTERS TO THE EDITOR.

TUNNEL NO. 9, NORFOLK & WESTERN RAILROAD.

Sir: Although peculiarities of alinement and construction occur on all roads, yet one presenting itself lately in the construction of the Ohio extension of the Norfolk & Western R. R. is eminently worthy of note. Shortly after the adoption of the line a tunnel revision was decided upon, thereby throwing out 900 ft. of line. To effect this, it was found necessary to make the tunnel 434 ft. long, with total approaches of 43 ft. maximum cutting and 900 ft. long, with 12° curve. Even with this alinement the P. C. of a 6° curve, running through most of the tunnel, came in the same, 51.5 ft. from one portal, making the tangent from the 6° curve in tunnel and 12° curve in approach only 198.5 ft. long. In projecting the line the P. I. came on the porch of a house, and in tracing the curve it was found to pass through the house, rendering a parallel curve necessary. Although but 434 ft. long, the materials struck were hard pan, loose rock (coal) and solid rock, requiring timber for 85 ft., and affording a striking example of the difficulties encountered in West Virginia railway construction, owing to the peculiar physical and geological aspect of the country. Respectfully,

Louis W. Atkinson.
Const'n Dept., N. & W. R. R.

GRIPS FOR CEMENT TESTING.

Sir: I inclose you a letter from Mr. Wolcott C. Foster, engineer in charge of the erection of a reservoir at Tarrytown, N. Y., which I think will be found of general interest.

The universal complaint of those engaged in testing cement who use the old form of grip is that very many of the briquettes break "up into the head," and not at the smallest section. Mr. Foster's experience has been that with the use of the W. R. C. grip (which is made with rubber facing at the point of contact) the machine breaks the specimen at or near the smallest section. As these results correspond with those obtained by other engineers with the same grip, it appears to me that we have at last found a grip that will break specimens in the center rather than "up into the head," as has been our experience heretofore with the old style of grip. In regard to the W. R. C. grip giving a high result, I would say that this has been the experience of other parties, using both forms of grip; but as the machine is the same, we would naturally infer that the W. R. C. grip gives the fairest result to the manufacturer of cement. I have always claimed that the grips should pull the briquettes in a perfectly straight line to give the fairest results. No one that I have referred the matter to can deny that the W. R. C. grip does this; consequently, I infer that the results are as near correct as it is possible to reach. If they are higher than the ordinary grip gives, they are nearer to the actual strength of the cement; because the machine registers the strength accurately in both cases. The variation is due to the defect in the pull, as between the W. R. C. grip and the old form.

As parties using cement testing machines have complained that they could not break the briquettes in the center, I trust those who have had this trouble will adopt this simple form of grip, and I think the result will be that they will find their difficulties are at an end. Yours very truly,

W. R. Cock.
Agent Riehle Bros. Testing Machine Co.

[The grip referred to was described and illustrated in our issue of Dec. 20, 1890. The letter inclosed is as follows: Ed.]

Riehle Bros. Testing Machine Co.

The "W. R. C." grip has proved very satisfactory to us. During the last year we broke some 1,500 or more briquettes of a number of different brands of cement, both Portland and Rosendale. Over 95% of these broke within ¼ in. of the smallest section, and not one broke more than ¼ in. from the center. The briquettes were all made and broken by a young man who had had no previous experience in this kind of work.

We usually found that bad breaks were caused by some visible defect in the briquettes. I have no doubt that your grip gives a higher tensile strength than the ordinary grip, but by making a proper allowance this objection, if it is an objection, may be overcome. We had no means at hand to ascertain the percentage of increase as we had only one grip. Yours very truly,

Wolcott C. Foster.

New York, Jan. 2, 1892.

REQUIREMENTS FOR STRUCTURAL STEEL.

Sir: I have been very much interested in the translation by Mr. Henning of the article on "Structural Steel." I do not at all agree with the German engineers that the bending test is a proper criterion of the quality of the metal; and I send you a test specimen, together with the report, as an illustration of the point. This steel is evidently a sample of burned steel, and the crystalline character of the fracture shows it to have been entirely unfit for structural purposes, as does also the low percentage of reduction of area. Yet the elongation, tensile strength, and elastic limit were all right, and you will note that the bending test showed very satisfactory results. The last blow of the hammer, after the metal had come down, sheared the metal and cracked it on the inside—something likely to happen with good steel, but not to so great an extent. The blow of the hammer shows the brittleness of the steel, although it had the ductility all right, as shown

by the elongation and the flow of the metal in bending. At the same time, it is evidently wrong steel for structural purposes.

This, in my judgment, is a good reason for having all five of the requirements; in addition to the tensile strength, elastic limit and elongation, should be determined the reduction of area and character of fracture.

It is a misfortune to the engineering public to have the statements go the rounds they have that the requirements of reduction of area and character of fracture are not essential in the specifications for material. A specification, I grant, should only be of sufficient character to exclude all material which should not be found satisfactory for the purpose for which it is to be used, and should be so broad in its character as to include all that could be satisfactorily used; but, in my judgment, the requirements of reduction of area and character of fracture especially are points that are essential in making specifications for good steel for structural purposes.

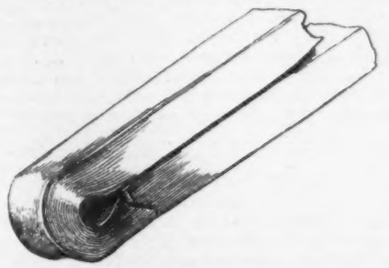
Very respectfully, ALFRED E. HUNT.

Pittsburg, Pa., Jan. 21, 1892.

[As far as the requirement for reduction of area is concerned, we do not see that Mr. Hunt's opinion differs much from that of the German engineers. In the translation of Prof. Krohn's article in our issue of Jan. 16 we find:

Amount of contraction at point of rupture is without theoretical value, but gives practical indications of quality of steels; for an abnormally low result is very suspicious and a minimum figure should be stated. According to past experience, "natural" basic soft steel of normal properties gives not less than 40% contraction, and this might be adopted as a practical value.

We are unable to find any proposition in the paper to do away with the specification for reduction of area, and such a proposition, if made, would be directly contrary to that announced in the paragraph just quoted. It is true there are engineers who hold that reduction of area gives misleading indications as to the excellence of metal in certain cases. In our issue of June 20, 1891, Mr. Paul Kreutzpointner, of the mechanical testing department of



Bending Test of Burned Steel.

the Pennsylvania R. R. at Altoona, explained the grounds which support this belief; but we do not understand that any engineer, American or foreign, objects to specifying a minimum reduction of area for structural material as a check on its qualities.

The point made by Mr. Hunt that bending tests may not be implicitly relied upon to detect burned material is an important one in view of the high value placed on such tests by the German engineers. Prof. Krohn says (p. 55 of our issue of Jan. 16) that both burned material and a too high percentage of phosphorus may be detected by bending tests. "In the case of the nicked bending tests the material bends but little and breaks suddenly with the well known, coarsely granular structure due to burning." The specimen whose record is given below certainly indicates the need of checking the results of bending tests by careful observation of the character of fracture, a matter which is not directly referred to in Prof. Krohn's paper, although we do not understand that the German engineers propose to omit this important aid in metallurgical testing.

The specimen sent by Mr. Hunt is illustrated in the accompanying sketch. It will be seen that the rack occurred when the portion which had been under compressive strain was given a tensile strain in closing it down with the hammer. The test record of the piece is given below.—Ed.]

Specimen cut from 4 in. round steel, length 1.075 ft., diam., 0.625 ins., area of cross-section, 0.6718 sq. ins. Results of test as follows:

Elastic limit, on specimen, lbs.	25,100
" " lbs. per sq. in.	38,850
Maximum load on specimen, lbs.	42,200
" " per sq. in., lbs.	62,810
Per cent. of elongation in 8 ins.	26.2
" " reduction of area	39.2
Character of fracture	100% granular
Cold bending test	180° flat

SIDE DOORS FOR RAPID TRANSIT CARS.

Sir: I have, like other people, often observed the rush and jam of the outgoing and incoming crowd at certain hours of the day on the elevated road in New York, and the consequent inconvenience, and even danger, to certain classes of passengers, such as ladies, children and the old; and I have also noticed the great rapidity, ease and comfort with which a crowded train is emptied on the underground road in London, where there is a door on each side for every group of 8 or 10 persons, whereas our cars carry from 50 to 100, including those who stand or hang on to the straps.

It would be a great improvement and save time both to the road and people if additional doors were introduced in the middle of the long cars of the elevated roads, not necessarily to be open except when the cars are very crowded.

Respectfully yours,
Wm. P. Craighill.

Baltimore, Md., Jan. 7, 1892.

[Col. Craighill's argument is a strong one in the abstract, but there is one important fact of experience which makes against it, viz., that the average stop on the London lines is some seconds longer than on the elevated lines. Moreover, in order to use side doors under existing conditions, it would be necessary to have an extra man to each car. That the London system does not commend itself to London experts as better than our own is indicated by the fact that on the new Greathead lines the cars have end platforms like our own, and no side doors. Between these two systems as now used we believe the balance of advantages is decidedly in favor of our own. In fact, the London system would probably break down completely if it were attempted to handle our present elevated traffic under it. The London traffic is very small in comparison. The Brooklyn Bridge cars have ordinary end doors, and a door in the middle of each side. With an ordinary double track line without platforms between the tracks it might be a practicable and effective plan to use one end door for entrance and the other for exit, though this might be inconvenient in long cars and would require some education of passengers. The best of all systems for handling a very heavy city traffic would probably be to have a middle platform and two outside platforms at the stations, and to use cars with a side door at each end of car on one side only for entrance, and a middle door only on the other side for exit. Then the incoming and outgoing passengers would not interfere with each other, and one of the most serious obstacles to handling very heavy traffic would be removed.—Ed.]

A NEW METHOD OF QUICK MULTIPLICATION.

Sir: I give below some examples of a method of multiplication in use by myself, it being a simplification of the ordinary method of cross-multiplication.

Multiply 3086 by 452. Cut a slip of paper the width of the height of one figure and write on it the multiplier reversing the figures thus | 254 |

Place this slip with its extreme left figure directly under the extreme right figure of the multiplicand, thus

3086
| 254 |

. Multiply together the figures in the same vertical column $2 \times 6 = 12$; set down 2 and carry 1. Then move slip one space to the left, thus

3086
| 254 |
2

; multiply together the figures in the same vertical column and take the sum of the products, and of the amount carried, thus

$2 \times 8 = 16$
$5 \times 6 = 30$
Amount carried = 1
Sum = 47

Set down 7 and carry 4. Then move slip and space to the left and proceed as before, thus

3086
| 254 |
872

$2 \times 0 = 0$
$5 \times 8 = 40$
$4 \times 6 = 24$
Amount carried = 4
Sum = 68

and again

3086
| 254 |
4872

; again

3086
| 254 |
94872

; again

3086
| 254 |
1394872

Remove slip altogether and the work stands:

3086
452
1394872,

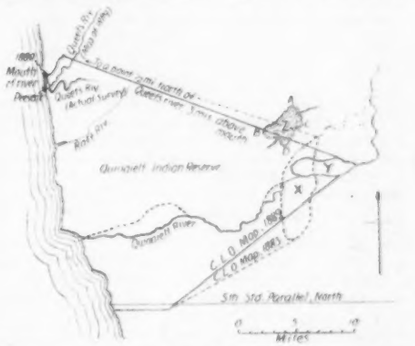
which checks as correct by the familiar process of casting out the nines. It will be readily seen that the use of the slip saves the mental fatigue required in cross multiplication to select the right figures, thus allowing the faculties to be concentrated on the multiplication and addition of the separate parts, which can all be done mentally and very rapidly after a little practice. Respectfully, Wm. B. Fuller.

Malden, Mass., Jan. 15, 1892.

"NORTHWEST POINT" OF THE QUINAIELT LAKE.

Sir: Noting the letter of Mr. Goodridge in your issue of Jan. 9, I still assert that there was no survey of Quinaielt Lake previous to that shown on the map sent you, though there have been attempts to sketch its outline, etc.; and to prove that the location, size and outline of the lake are even now a matter of conjecture with the government officials, I send a map showing:

A (shown on map by dotted lines), the lake as on the official map of the General Land Office, 1883, which agrees with the sketch from Rand, McNally & Co.'s Atlas (who, by the way, do not make original surveys, nor are they particular to give exact lines and locations on their railway maps).



Boundaries of Quinaielt Indian Reserve as Shown on Official Maps.

(The Actual Position and Outline of Quinaielt Lake are Shown at Z.)

B, the lake as shown on map of 1889, which is totally different from the first.

C, the actual location and outline of the lake.

As there is a variety of official maps might not the commissioners who negotiated the treaty in 1855 have had still another? It is more probable, however, that the Indians gave them their ideas about the lake.

The fact that the area of the reservation agrees with the earlier maps quoted does not seem conclusive evidence that the lake as shown thereon was according to the ideas of the commissioners. There could be numerous locations, sizes and outlines of a lake, and lines run from the fixed points on the coast would inclose the 224,000 acres; they necessarily had to give an estimate, otherwise the Executive would not know whether it was proposed to grant 10,000 acres or 10,000,000. The question of the exact location of the lines can not depend on an estimate of area founded on guesswork.

The Indians themselves do not claim on the north shore of the lake beyond the point B (on first map, p. 16, issue of Jan. 2). It is tolerably certain that the original idea of their fathers was handed down correctly. If the commissioners sketched the lake incorrectly, through carelessness or misunderstanding the description given by the Indians, it would be unjust to the present interested parties to conform the location of the reservation lines to ideas derived from an incorrect map.

In the editorial comment the statement is made that the only equitable effect of more accurate surveys, whatever they develop, would be to start the boundary line from the more westerly of two northerly points, had there chanced to be two. In the latter map of the General Land Office they do not follow this theory. Quinaielt.

Tacoma, Wash., Jan. 15, 1892.

[From one point of view it seems unreasonable that two maps which were made without any exact knowledge of the location of the lake in 1883 and 1889 should fix the interpretation of a treaty made in 1855, when still less was known, but in the case of an ambiguous description like this (see issue of Jan. 2) our judgment is that any court would hold them to be decisive evidence of what the true intent of the treaty was, viz., that the Indians should control at least half of the borders of the lake. Without these maps, in the case as first submitted, we should hold the point B to be the true "northwest point." With these maps as evidence of intent (or at least of government concessions nine years ago, we think that the Indians can, if they choose, claim the point A to be as clearly the "northwest point," within the intent of the parties to the original treaty so far as it is now possible to determine that intent. If they do not choose to make the claim, but concede the point B, that again puts a new face on the situation.—Ed.]

AN INTERESTING PIECE OF ROAD CONSTRUCTION.

Sir:—Having read in your valuable paper of the finding of an old log causeway about 1,900 years old, and several feet below the surface in a marshy piece of ground, it reminded me of a piece of road which I constructed in water in the village of Hyde Park (now in the city of Chicago) that may be of interest to your readers.

While Village Engineer and Superintendent of Public Works of said village (situated south of and next to the city of Chicago) in 1868, I was instructed to construct that part of Stony Island Ave. from 83d to 91st St., a distance of one mile, to connect the portions already made. The line crossed a marsh about one mile wide, which extended from about two miles west, easterly to Lake Michigan and southeasterly to Calumet River, a distance of some two miles, and was at that time all covered with water, from a few inches to two feet deep. Wild rice grew all over that portion of the marsh, about eight feet high, and the stalks were from ¼ to ½-in. in diameter at the bottom. Through the central portion of this marsh was an open water-way about 10 ft. wide in the channel proper, with no perceptible current, which widened out into small lakes, every few hundred feet.

The channel and lakes had from 3 to 4 ft. of water and about the same depth of black slush, or decayed vegetable matter. No man or beast had ever crossed this marsh on the line of this street, as it was the worst place in the whole marsh.

With the assistance of fence boards, which each one carried for safety, and with poles, bush-hooks, and an iron rod, myself and party succeeded in getting across. We cut an opening the whole distance and set a row of stakes on the center line every few hundred feet, and also sounded it every hundred feet. We found the turf to be about a foot thick, and from 2 ft. to 6 ft. of soft black vegetable mold underneath; then a hard bottom of blue clay. Although the marsh was covered with water, it was from 3 ft. to 4 ft. above the ordinary surface of Lake Michigan. The water courses not having at that time been opened direct to the lake, the water lay on the surface until it evaporated.

A profile was drawn, and an estimate made, which varied but little from the final cost, which was about $10,000. At the south end of 91st St. lies Stony Island, which is a rocky upheaval over 20 ft. above the adjoining marsh. This island or upheaval is south of, and next to 91st St., and east of Stony Island Ave., and is half a mile wide from north to south, and one mile long from east to west. On it a stone quarry was in operation; also a stone crusher. The material was a flinty limestone, which we were then using for road making.

The first thing was to begin at the dry ground on the south end, and place an 18-ft. inch board, 1 ft. wide, on the outside, lengthwise, 9 ft. from the center; then one in the same manner in the center, 6 ft. in advance of the first, and then one on the opposite side, 6 ft. in advance of the middle one. Then the three pieces laid lengthwise were covered with 18 ft. sound boards, 1 in. thick, laid crosswise and close together, and nailed as fast as laid to keep them in their places. On these were placed three more lengthwise, as at first, one in the center and one on each side, and these were nailed through into the under ones. Next, all the wild rice for a space of about 75 ft. on each side was cut down and pitched with forks on to the floating platform or roadbed. It made a compact covering of about 2 ft. thick. At the end of the first 500 ft. a turn around for teams on one side was made of boards, doubled, 36 ft. square, thoroughly nailed.

Then the whole 500 ft. of roadbed was covered 16 ft. wide with about 15 ins. thick of broken stone, and on this was placed 3 ins. of crushed stone.

After finishing the first 500 ft, the turn around was removed to the end of the second 500 ft., and so on, to completion. Near the middle of the marsh was a lake which the line crossed, some 200 ft. wide on the line of the street, by about 400 ft. long. The 200 ft. was crossed with a bent bridge 50 ft. long and the balance with floats, the same as the marsh, but wider. The bridge was placed on the pond-lily roots that everywhere abounded in the bottom of all these small lakes, and left about 2 ft. higher than needed to allow for settling; but it has not yet settled more than some 6 ins., although a pole can be run down between the network of roots and into the slush underneath about 3 ft. below the bottom of the sills, before the hard bottom is reached.

The road settled on an average about 2 ft., with the exception of two or three short distances, where it settled 3 ft.; but it did not break through the turf in any place. At a high stage of water, some places, for a few feet in length, would be one foot under water.

The road has stood over 23 years and has been considerably travelled and is in good condition to-day. It has had but very little top dressing during the whole time. Since the road was constructed the marsh has nearly all been drained, and has mostly become solid, and the land in it, which at that time was not worth $25 per acre, has just been sold for $2,500 per acre.

The Calumet and Chicago Electrical Railway is soon to be laid on this road, and it is solid enough to carry a 40-ton locomotive.

Geo. W. Waite, Civil Engineer.

Chicago, Ill., Jan. 16, 1892.

NOTES AND QUERIES.

I. T., Fresno, Cal., asks where he can find a report or description of Edison's method of separating iron from ore by electricity. As Mr. Edison has taken great pains to keep the details of his system of ore separation a profound secret, our correspondent will hardly be able to find any description of it in print. He may possibly gain some information on the subject by hunting up in the "Official Gazette" the patents on this subject issued to Mr. Edison, and obtaining copies of the drawings and specifications. Mr. Edison and his associates have purchased an enormous deposit of low grade ore at Ogden, N. J., which they propose to mine in open quarry and concentrate. A large plant has been established for crushing and concentrating the ore, but so far, we believe, it has not been brought into satisfactory working order. No commercial work has yet been done, and the public is rigidly excluded. The general subject of magnetic concentration has been discussed in recent numbers of Engineering News. In our issues of Oct. 17 and Dec. 26, a full description was given of a plant which is concentrating iron ore in large quantities at a cost of less than 7 cents per ton.

W. Y. asks: Have you any knowledge of experiments having been tried to conduct smoke and cinders from the smokestack of the locomotive, through a pipe, back over the top of the train? If any such experiments have been tried can you inform me where, when and by whom they were made, and the difficulties met with?

All kinds of devices of this kind have been tried from the earliest days of railroading, but never with permanent success. The idea is plausible, but it is still only an idea.

H. M. asks: In reckoning the tonnage life of a steel rail, what is the customary manner of estimating the tonnage? I find that our tonnage records show only the actual tons of freight carried. I presume I could get at the number of locomotives and number of loaded and empty cars passing over the line. Are not all of these taken into consideration in reckoning the tonnage?

All tonnage is invariably taken into account, and its amount is usually obtained by taking the number of cars and locomotives over the rails and assigning an average weight to the cars. The preponderance of evidence is that the locomotives alone cause half to three-quarters of the wear, and that the ton unit is not so good a basis of comparison as the number of trains over the road, still the ton unit is the more common. Its effect is to show great tonnage life for rails over which long trains run, and vice versa, because the light car wheel loads cause little wear.

R. I. S., Chicago, asks for a list of the later railway bridges, built of mild or soft steel, within the last five or six years. He also asks for a record of failures of steel plate girders, or of steel pockets holding the ends of longitudinal girders. We have no such record of failures, and do not remember any special and important case of bridge or girder failure where the direct cause was the use of mild steel as compared with wrought iron. Some of our readers may be better posted. A list of the later and more important steel bridges can be compiled from data gathered from bridge building and railway companies and from the technical journals. We have never had occasion to attempt it.

A correspondent asks us whether a draftsman can be held liable for damages resulting from mistakes made by him which entail loss to his employer. We answer no, unless a specific contract has been entered into between the parties in interest specifying a penalty for such mistakes. The employer, under ordinary circumstances, has only the power to discharge and cannot legally even retain salary due at the time of discharge, as we understand the law, unless he can establish a case of willful injury or fraud.

R. A. H., Portland, Ore., asks concerning the schedule of surveyors' fees for Chicago, published in our issue of Dec. 26, whether these fees were fixed by the surveyors themselves or by some other authority. We understand that the schedule was made by a committee appointed by the city surveyors. Mr. C. McLennan, 308 Opera Block, Chicago, was chairman of this committee and can doubtless give all the information required.

WORLD'S COLUMBIAN EXPOSITION.

The exposition at Chicago in 1893 will be the largest and most extensive, as it will in all probability be the finest, of all the international expositions that have yet been held. In connection with our articles on the Columbian Exposition commenced in our issue of Jan. 16, we give herewith some interesting particulars and figures in relation to earlier expositions. We give also general plans, showing the arrangement of buildings and grounds of the Columbian Exposition and some of the previous expositions, drawn to the same scale, and showing very clearly their comparative magnitude. The following table shows at a glance the areas of these expositions:

	Areas in acres.		
	Floor.	Under roof.	Total, including grounds.
London, 1851	22.72	18.27	.....
New York, 1853	5.70	.....	.....
Paris, 1855	....	29.00	34.50
London, 1862	....	25.00	.....
Paris, 1867	....	27.00	150.00
Vienna, 1873	....	a34.88 b40.00	.....
Philadelphia, 1876	....	a50.69 b71.47	285.00
Paris, 1878	a46.00	b80.00	152.00
Paris, 1889	....	75.50	238.00
Chicago, 1893	....	a150.10	666.00

a, main buildings; b, all buildings.

London, 1851.

The first international exhibition, that held in London, England, in 1851, consisted of one building, having two extensive galleries, making three stories in all. This building was of iron and glass, 1,840 ft. long and 408 ft. wide, with a projection on the north side 936 ft. long and 48 ft. wide. It covered a total area of 18.27 acres, and the floor space was as follows:

Ground floor	17.74 acres.
Galleries	4.98 "
Total floor area	22.72 acres.

The total cost of construction of the building was $694,800, and the building was afterward sold for $365,000. The total cost of the exposition was about $1,500,000. There were 13,938 exhibitors, of whom 6,556 were from foreign countries. The exposition was opened on May 1 and closed Oct. 15, and the total number of visitors was 6,039,195 during the 144 days it was open.

New York, 1853.

The "Exhibition of the Industry of All Nations" was the result of private enterprise. The exposition was organized by a company, and was countenanced and aided by the government, the exhibition building being made a bonded warehouse. The building was located on the block bounded by 40th St., 41st St., 6th Ave. and the Croton reservoir, and was in the form of a Greek cross, with a dome 100 ft. diameter at the middle. It had two stories, and the space between the arms was covered in at the level of the first floor. The length of both stories was 451 ft.; the first floor 75 ft. wide, and the second floor 21 ft. wide. The floor space was as follows:

First floor	3.6 acres.
Second floor	2.1 "
Total floor area	5.7 "

Paris, 1855.

The original plan was for a permanent industrial palace and a separate building for fine art display, but additional accommodation had to be provided in temporary structures. The Industrial Building was 827 ft. by 354 ft., with an annex 3,833 ft. by 80 ft. The area of the buildings and grounds was as follows:

Industrial Palace	12.50 acres.
Annex	10.25 "
Fine Arts	4.00 "
Panorama and passages	2.25 "
Total area covered	29.00 "
Grounds	5.50 "
Total area	34.50 "

There were 20,788 exhibitors, occupying a space of about 25 acres. The total number of visitors was 5,162,330 during the 200 days the exposition was open.

London, 1862.

The second exposition at London, held in 1862, had a main building 1,150¾ ft. long and 50 ft. wide, with two wings 750 by 25 ft., and one gallery floor. The area covered by the buildings was about 25 acres, and there were about 29,000 exhibitors. The number of visitors was 6,211,103 during the 171 days the exposition was open. The cost of the exposition was about $3,000,000.

Paris, 1867.

The general design and arrangement, as suggested by Prince Napoleon, consisted of a central garden surrounded by an elliptical building consisting of seven concentric galleries. A certain space in each gallery was allotted to the exhibits of a country, the galleries dividing the exhibits into classes, and radial avenues separating the spaces for different nations. The dimensions of this main building, including central garden, were about 1,608 ft. by 1,247 ft., and the total area of the buildings was 37 acres. The total space occupied by the exposition was about 120 acres, and the cost about $4,000,000. The number of exhibitors was 50,226, and they occupied a space of about 80 acres. There were 10,200,000 visitors during the 217 days the exposition was open.

Vienna, 1873. (Fig. 1.)

The exposition held at Vienna in 1873 had a main building called the Industrial Palace, which consisted of a nave 2,953 ft. long and 82.66 ft. wide, with 16 intercepting transepts 572.5 ft. long by 51 ft. wide, and a rotunda 354 ft. diameter. This building had an area of 21.07 acres, with closed courts aggregating 5.94 acres, and open courts 15.10 acres. There were also a Machinery Hall, 125 ft. by 2,000 ft., an Art Building 100 ft. by 600 ft., and two buildings forming the Agricultural Hall. The exposition was located in the Prater, the great park of Vienna, which has an area of about 4,000 acres. The area of buildings was 40 acres, that of the main buildings being as follows:

Industrial Palace	21.07 acres.
Machinery Hall	9.85 "
Agricultural Hall	2.58 "
Art Building	1.38 "
Total	34.88 "

The number of exhibitors was about 42,000. There were 7,254,687 visitors during the 186 days the exposition was open.

Philadelphia, 1876. (Fig. 2.)

The Centennial Exposition held at Philadelphia in 1876, was located in Fairmount Park, which has an area of 2,991 acres. The total area of the grounds was 285 acres, while the area of the main buildings was 50.68 acres, and that of the minor buildings 20.78 acres, a total of 71.47 acres, as shown by the following table comparing the areas of the buildings with those of the Chicago Exposition.

	Philadelphia, 1876. Acres.	Chicago. 1893. Acres.
Manufactures and Liberal Arts	22.15	30.5
Machinery		9.8
" Annex		6.2
Electricity	14.00	5.5
Mining		5.6
Transportation		5.5
Power	0.53	1.1
Agriculture	8.72	9.2
Fisheries		1.4
Aquariums	1.25	0.8
Horticulture		5.8
U. S. Government	2.33	3.4
Womans	0.80	1.8
State ([1]Pennsylvania; [2]Illinois)	[1]0.17	[2]1.7
Admininistration	0.74	1.6
Total comparable	50.69	89.9
Total minor structures	20.78	
Total area under roof	71.47	

The total area of buildings at Philadelphia was classified as follows:

	No.	Acres.
Exhibition buildings, official	45	37.53
Concessions	41	4.62
United States Govt. buildings	7	2.63
Foreign govt. buildings	15	0.86
Private exhibition buildings	56	2.77
Private exhibits, outside bldgs.	41	0.98
State buildings	24	1.99
Urinals	15	0.07
Water closets	5	0.01
Total	249	71.47

There were about 7 miles of sewers outside of the buildings and independent water works were provided, with a daily capacity of 57 gals. per head for 45,000 persons. There were two Worthington duplex direct-acting pumping engines of 1,000,000 and 5,000,000 gallons daily capacity, forcing water to a wrought iron stand-pipe 120 ft. high and 4 ft. diameter. The greatest amount pumped in one day was 2,805,044 gallons, and the total amount during the exposition was 499,318,620. About 1,000,000 gallons, per day went to the great fountain, and thence about half the quantity flowed to the lake, from 500,000 to 600,000 gallons per day being used for the condensing apparatus of the Corliss engine. There were about 12¼ miles of water pipe, 303 fire hydrants, 32 ordinary hydrants, 924 water closets, 372 urinals, 601 wash basins, 95 sinks 31 baths, and 35 fountains, 17 of the latter being of large size. The buildings and grounds were lighted by gas, supplied from the city works through about 8 miles of mains in the grounds. The total consumption was 33,044,500 cu. ft., or 157,300 cu. ft. per night. The exposition was accessible by various routes, and the total carrying capacity per hour was about as follows:

Railways	6,250	passrs.
Street cars	12,180	"
Steamboats	2,500	"
Cabs, omnibuses and other vehicles	1,000	"
Total per hour	21,930	"

Transportation within the grounds was provided for mainly by a double-track narrow gage surface railway 5.5 miles long, with sharpest curves of 250 ft. radius and a maximum grade of 2.5%. The track was of 45 lb. iron rails on ties 4×6 ins., laid 24 ins. c. to c.,

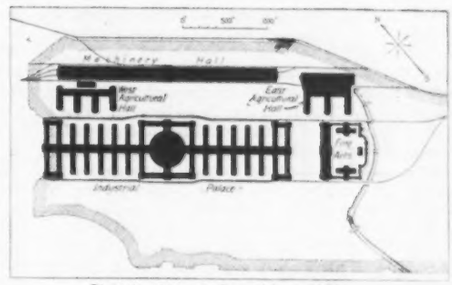


Fig. 1. Vienna Exposition, 1873.

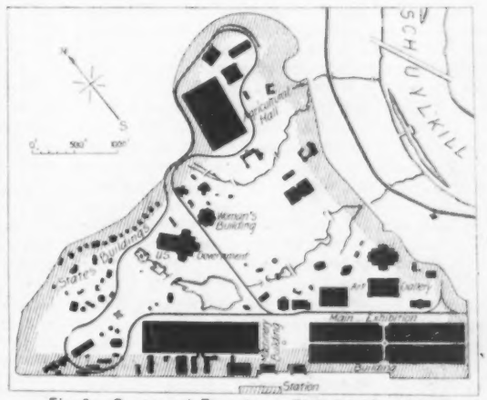


Fig 2. Centennial Exposition, Philadelphia, 1876.

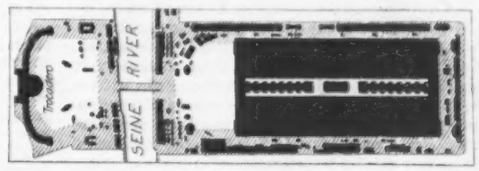


Fig. 3. Paris Exposition, 1878.

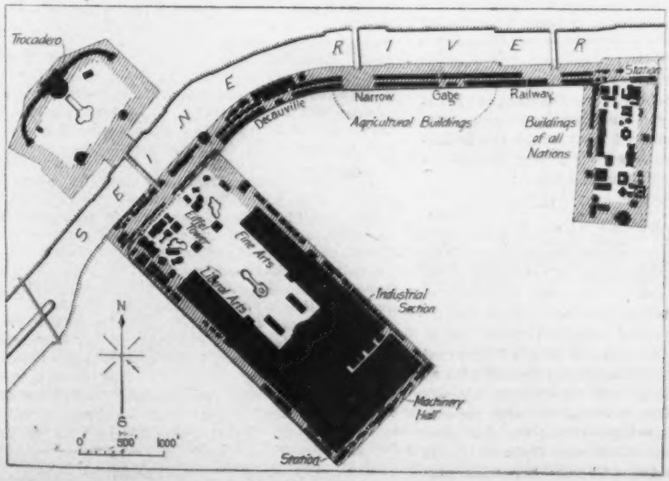


Fig. 4. Paris Exposition, 1889.

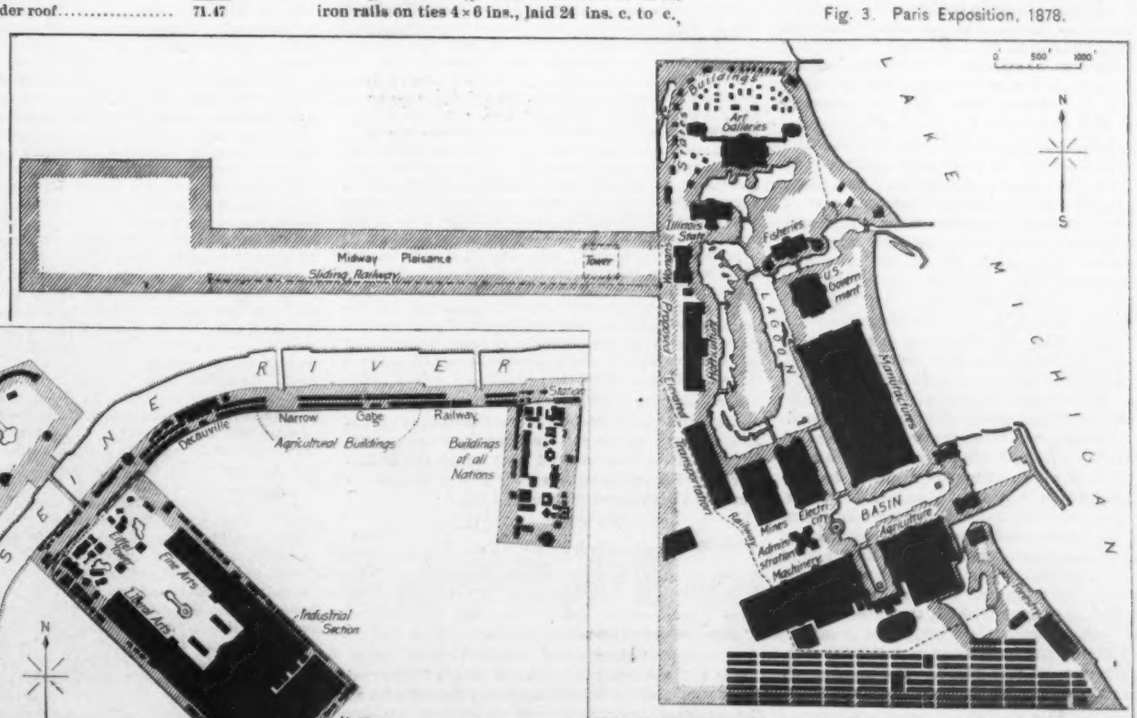


Fig. 5. World's Columbian Exposition, Chicago, 1893.

(In all figures hatchings denote boundaries of exhibition grounds and solid black areas denote buildings.)

GENERAL PLANS OF INTERNATIONAL EXHIBITIONS, DRAWN TO SAME SCALE SO AS TO SHOW COMPARATIVE AREAS.

and the roadbed was drained but not ballasted. It was operated by engines built by different makers and cars with open sides and transverse seats. At the stations were raised platforms level with the floor of the cars. The total number of passengers carried was 3,812,794 from May 15 to Nov. 11. Wheel chairs were provided in the buildings and grounds. Power for driving the shafting in Machinery Hall was furnished by the great Corliss beam engine of 1,400 HP., having cylinders 40 ins. diameter and 10 ft. stroke, and a flywheel 29 ft. 8 ins. diameter. The total number of admissions was about 10,000,000 during the 159 days the exhibition was open. The highest and lowest numbers in any one day were 274,919 and 12,720 respectively.

Paris, 1878. (Fig. 3.)

The elliptical arrangement adopted in 1867 having proved unsatisfactory, owing to different countries not contributing in the same proportion to the various groups, a rectangular plan was now adopted, and the groups were generally each located in a series of buildings in which space was assigned to the different countries. The same difficulty was met with, however, in the final arrangement of the exhibits. The main building had a floor space of about 46 acres and the total area of the buildings was about 60 acres, while the area inclosed for the exposition was about 152 acres. There were 52,000 exhibitors. The total number of admissions was 16,159,719, or an average of 83,297 per day during the 194 days the exposition was open. The largest number of admissions in one day was 200,613, of which 182,249 were by payment.

Paris, 1889. (Fig. 4).

The International Exposition held at Paris in 1889, and which was visited by many American engineers, is the largest that has yet been held, but it will be seen by the figures given in this article that it will be far surpassed in point of size by the Chicago Exposition of 1893. Many of the following particulars are taken from a paper by Mr. Octave Chanute, M. Am. Soc. C. E., read before the Western Society of Engineers in 1890, and from a report made in 1889 by Mr. E. T. Jeffery to the Chicago Citizens' Executive Committee, in connection with the then proposed Columbian exposition. Both of these gentleman had made a careful investigation of matters relating to the exposition. The main buildings were located on the Champ de Mars. The Machinery Hall was 1,378 ft. long by 475.5 ft. wide, and from it extended a central transept, or gallery, 685 ft. by 98 ft., at the outer end of which was a great dome, 98 ft. diameter, carried on columns 131 ft. high, the height to top of the dome being 200 ft. On each side of the transept, and extending the full length of Machinery Hall, was a series of 7 iron sheds, each about 82 ft. wide, for miscellaneous exhibits. Extending about 440 ft. from these buildings were two sets of sheds similar to the others, connecting those used for miscellaneous industries with the transepts about 384 ft. long and 105 ft. wide, which extended across the ends of the Palace of Fine Arts and Palace of Liberal Arts. These buildings are each 738 ft. long and 275 ft. wide, with galleries 50 ft. wide on each side. Each has, in the center of the nave, a dome 100 ft. diameter and 197 ft. high. This group of buildings covered an area of about 54 acres. The "buildings of all nations" were located on a separate piece of ground, connected with the main grounds by a narrow strip along the river, upon which strip buildings were also erected. The total area of all the grounds enclosed for exposition purposes was about 238 acres, of which about 75.50 acres were under roof, including the Palace of the Trocadero, 3.25 acres. The total number of admissions was about 32,354,111 during the 164 days the exposition was open, and was about double the original estimate. Of this total number, 25,398,000 were by ordinary tickets, the others being by season and gratuitous tickets. The greatest number of admissions in one day was 387,877, and the smallest number was 36,322. The number of exhibitors was 60,000. The Exposition was opened May 5 and closed Oct. 31, 1889.

The total area lighted by electricity was about 86 acres, of which 68 acres were gardens and open spaces. The amount of lighting was equivalent to about 2,000,000 c. p., or about three times the amount of public lighting throughout the city of Paris. This light was furnished by 1,150 arc lamps and 10,000 incandescent lamps. In addition there was an extensive gas lighting plant. The water supply was furnished by a French engine of the Wheelock type and a Worthington high duty engine with a daily capacity of 6,000,000 galls., this latter engine pumping water from the river Seine for manufacturing purposes. The following is a summary of the expenditures:

Fine arts, liberal arts and art galleries	$1,352,920
Machinery Hall	1,502,785
Miscell. industries galleries	1,177,125
Sewers and grading	104,965
Horticultural exhibition	60,000
Agricultural exhibition	120,000
Parks and gardens	406,530
Offices and police stations	91,789
Fencing	90,000
Roads	5,130
Bridges	40,000
Water and gas	120,000
Railways	72,650
Lavatories	60,000
Reserve funds	635,590
Service, Machinery Hall	18,600
Horticultural shows	13,200
Social economy	15,120
Total	$5,886,395

Mr. Jeffery's report stated that the combined carrying capacity of public conveyances to the exposition was 173,750 passengers per day, but it proved entirely inadequate. This included the Belt Railway, street cars, omnibuses, river steamers, cabs, etc. We quote below Mr. Jeffery's remarks as to intramural transit arrangements, and it is to be hoped that the lesson of the Paris Exposition will be duly regarded by the authorities of the vastly more extensive Chicago Exposition:

The Decauville Railway (Eng. News, June 1, 1889) was about 2 miles long, of 2 ft. gage, and afforded the chief means of passenger transportation between Machinery Hall and other places on the Champ de Mars and the Esplanade des Invalides. Its trains were run from 5 to 10 minutes apart, and on days of large attendance they were insufficient to move the crowds which pressed forward for passage. Instances were noted in which passengers were kept waiting 25 minutes, packed in a dense mass at the station, until by successive trains the pressure was relieved. It is said to have carried upward of 6,000,000 passengers, but it would have been more efficient if it had been planned and built in a substantial manner, as a belt railway, making the entire circuit of the grounds. This was proposed, but not carried out, for, guided by the experience of 1878, about 14,000,000 visitors were anticipated, while, in point of fact, nearly twice that number were secured. As additional means of transportation within the grounds, there were numbers of rolling chairs, liberally used in visiting the countless objects of interest and 100 Egyptian donkeys with their native drivers added to the delight of children and the pleasure of adults by carrying them for short distances.

To most persons, however, even a partial survey of the great attractions involved a fatiguing task, performed on foot. It was variously estimated that a thorough exploration through all the different passages entailed a walk of from 25 to 50 miles, and there was some preliminary discussion as to the best means of saving visitors this excessive labor. Two suggestions were made. One to provide a traveling sidewalk, something in the form of a continuous train of platform cars, level with the floor of the principal buildings, and moved at such a speed as to permit visitors to safely step on or off, or to be carried along standing thereon, or to increase their speed by walking. The other plan was to provide a series of passenger carriages suspended under the principal galleries reached by staircases, and put into motion either by a cable or by electricity. Neither of these were adopted and the transportation of visitors within an exposition is still an unsolved problem.

The following table shows the comparative areas and estimated cost of some of the buildings at Paris and Chicago which can most readily be compared, but it must be remembered that while the framework of French buildings was of iron, that of the American buildings is of iron and wood:

Buildings.	Paris, 1879. Area, acres.	Est'd. cost.	Price per acre.	Chicago, 1893. Area, acres.	Est'd. cost.	Price per acre.
Machinery	15.04	$1,423,208	$94,980	17.1	$1,200,000	$70,169
Misc. Ind'*	28.79	1,027,295	35,597	30.5	1,000,000	32,787
Fine arts	5.60	752,104	134,900	4.8	500,000	104,167

* Manufactures Building at Chicago.

Chicago, 1893. (Fig. 5.)

It is not necessary here to say much in general about the World's Columbian Exposition of 1893, as the accompanying plans and the figures already presented will show how it compares with preceding expositions, and in later issues we shall give more detailed descriptions. In our issue of Jan. 16 we gave a map of the grounds, together with particulars of the present condition of the work and the area and estimated cost of the buildings, as well as the estimates of expenditures and resources, which need not be repeated here. In view of the great area of this exposition and of the probable enormous attendance, there are two points which should be given special attention by the management: First, to be prepared to deal with great crowds of people; and, second, to provide ample accommodation for carrying visitors about the grounds. The areas of and attendance at the two most recent expositions are given below:

	Philadelphia. 1876.	Paris. 1889.	Chicago. 1893.
Area of main building, acres	50.68	53.85	05
Area of all buildings, acres	71.47	75.50	..
Area of ground inclosed, acres.	285.00	238.00	666
Total number of visitors	10,0. 0,000	32,354,111	...
Highest number in one day	274,919	387,877	...
Lowest number in one day	12,720	36,322	..

The following table gives particulars of the attendance at the previous expositions referred to in this article:

	Days open.	Number of visitors—Total.	Highest in one day.	Lowest in one day.	Average per day.
London, 1851	144	6,039,195	.....	.....	41,939
Paris, 1855	200	5,162,330	.....	.....	25,812
London, 1862	171	6,211,103	.....	.....	36,322
Paris, 1867	217	10,200,000	.....	.....	47,000
Vienna, 1873	186	7,254,687	.....	.....	39,003
Philadelphia, 1876	159	10,000,000	274,919	12,720	62,892
Paris, 1878	194	16,159,719	200,613	.....	83,297
Paris, 1889	164	32,254,111	387,877	36,322	192,28:

IMPROVEMENTS IN FREIGHT CAR CONSTRUCTION.

At the last meeting of the Western Railway Club a review of the progress made in freight car construction during the past score of years was presented by Mr. D. L. Barnes, M. Am. Soc. M. E., showing that the general tendency is toward the substitution of steel for wood in order to withstand the increased strains due to heavier loading and greater buffing and pulling strains in service. We abstract the paper as follows:

The freight car of twenty years ago weighed about 0.8 lb. per lb. of carrying capacity. The car of the present day weighs only 0.5 lb. per lb. of capacity. Thus there has been 37½ decrease in the dead weight of box cars per ton of full load. The actual increase in capacity has been from 24,000 lbs. to 60,000 lbs.

To carry this increased load, the sills, which were formerly 4 x 7 ins., have been increased to 5 x 9 ins. Even this, with the use of the best timber the market affords, has not been sufficient, and car sills break because they are too weak to stand the shocks and strains of service, not because they are decayed or worn out. Yet wood frames are as heavy as it is economical to make them. A steel under-frame having more than twice the strength of the best wooden frame can be made that will weigh only about one-half as much, and the saving in the total weight of the car is about 16% or 5,000 lbs. This saving means an average increase of one loaded car in every ten or twelve without increasing the weight of the train.

European cars are now almost universally built with steel or iron under-frames, and the same is true of Mexican cars. In this country iron pipe sills and composite sills have been tried and found wanting. The Harvey plan of steel under-framing (Eng. News July 11, 1891) is probably the best that has been tried here.

The great reduction in cost of rolled steel beams has made steel car construction possible. Formerly the price was 3½ cts. per lb. It is now less than 2 cts. per lb. ($40 per ton). A steel under-frame costs about $10 more than a wooden one and weighs 5,000 lbs. less. Rivets are better than bolts for fastening metal frames together. Repairs on metal frames are light. In Germany metal frames which have been in service 15 or 20 years appear as good as when first put into service. It has been estimated that the life will be from 50 to 80 years, but this would not be true of refrigeration and stock cars unless moisture were kept away from the sills.

The use of steel floors, lining and siding has been advocated by some; but the time for these things has not yet come. Indeed, wooden floors seem to be a permanent necessity, in order that cleats and braces may be nailed thereon to keep merchandise from shifting in transit.

A radical improvement in car construction has been made by dispensing with the draft sills and dropping the car floor so that the center sills act as draft sills.

Body Bolsters.—The latest and strongest form, in use on the Chicago, Burlington & Quincy R. R., is shown in Fig. 1. For use with metal sills some changes in the design will be necessary.

Draft Rigging.—This still causes more expense in repairs than any other part of the car. Cast iron stops have been replaced by wrought iron, pressed steel, malleable iron and cast steel. All the recent designs of drawbar stops are made in what is equivalent to one piece and have a wide bearing on the sills. Fig. 2 shows a recent design of drawbar stop, which is admirable for its simplicity and low cost. Its parts can all be made in the ordinary bending machine. The modern draft gear never

breaks; it bends; and its resistance to rupture when attached to a wooden sill is over 150,000 lbs., while the old draft rigging had less than 80,000 lbs. Notwithstanding this, the repairs are no less than before, because of the increased shocks in service with heavier locomotives and cars. But the modern draft rigging is as heavy as need be made for a wooden sill. It is the sill that fails now in case of heavy shock, not the draft rigging.

The draft sills were formerly secured to the center by vertical bolts. The present construction uses keys as

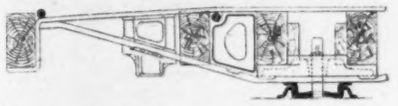


Fig. 1. Body Bolster in use on C. B. & Q. R. R.

well and carries the draft sill the whole length of the car, making really a double center sill. The lowering of the car floor and dispensing with the draft sills avoids this. Fig. 3 shows the method of supporting the drawbar and strengthening the end sills in use on the standard 60,000-lb. freight cars of the C., B. & Q. R. R., which are built on this plan.

Reliance should not be placed on the draft rigging to absorb buffing shocks. A flange is usually cast on the top side of the drawbar and strikes against a wooden block bolted to the end sills. This block should always be protected by an iron plate, and the drawhead should come to

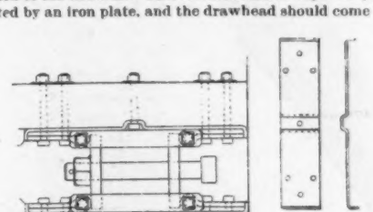


Fig. 2. An Improved Drawbar Stop.

a bearing against it when the draft springs lack about ¾-in. of being fully closed. Attempts have been made to increase the capacity of the draft gear to absorb shock by the use of friction or compressed air buffers; but the amount of shock which can be absorbed in this way is too small to be of moment.

Trussing and Bracing.—The old type of car had a truss only 10 ins. deep, the rod secured at the end by a 2½-in. washer. Modern practice uses a truss 27 ins. deep, secured at the end by a 4-in. washer bearing against an iron plate. The truss rod is 1¼ ins. diam., with ends upset for the screw threads. The best practice is to rely on the truss and sills to carry the load of the car and design the truss in the sides of the superstructure to carry only the strains on that structure.

The best car builders now use malleable iron post plates to prevent the inclined braces and posts from pounding and working into the side sills. End posts have been increased from 3½ ins. to 7 ins. in thickness, and rest in a metal shoe on the end sill. This construction has caused a decided decrease in bulged ends.

Center Plates.—The old style center plates were intended to be as much as possible like a ball bearing, permitting the car to tip easily on to either side bearing. Modern practice substitutes a large flat plate, which prevents the car from tipping onto the side bearings except on curves. It is found that the side bearings cause most of the resistance of the trucks to turning. With flat center plates well oiled, the reduced flange friction in rounding curves is estimated to increase the average train which a locomotive can haul on a crooked road about 1 car in 30.

Trucks.—Improvements have been greater here than in any other part of the car. Iron and steel have largely replaced wood and have simplified the design of the truck. Pressed steel trucks are largely used in Europe and Mexico and about 200 have been put into service in this country. A marked change in truck construction was the adoption of the swing motion to secure easy riding. While low speeds were in vogue this was all right, but as speeds increased, the oscillation became a serious objection and the swing motion is now being generally discarded.

Car Wheels.—A great improvement in car wheels has been made within the past few years, the contracting chill leading the procession. The record of mileage of chilled wheels is now 25% to 50% superior to what it was before the modern process of manufacture was introduced.

Brake Beams.—The modern brake beam consists of a compression member with its material so disposed as to give greatest stiffness for least weight, and a tension member of any section sufficiently large. The heads are of malleable iron or cast steel and weigh less than one-third as much as the clumsy head used on wooden beams. An initial strain is put upon the members of the beam by screwing up the tension member, and thus all parts are brought to a firm bearing before they are strained in service. Many roads, however, still pursue the short sighted policy of equipping cars with the old wooden brake beam, which is practically useless on cars fitted with air brakes.

Car Brakes.—There is a strong probability that the Government will compel the use of power brakes on freight trains. Roads that have used freight train brakes find their records show that the reduction in the number of wrecks, the increased rapidity with which trains can be handled, and the increase in speed of freight trains, quickly pay the first cost of the power brake and its maintenance.

There is also a prospect of competition in the air brake market. Several new brake companies are offering devices claimed to be equal to the Westinghouse. However, an elaborate series of actual road tests should be made on any new brake before accepting it as safe to use.

Ore and Coal Cars.—The hopper type of car must remain the favorite in this class. Some improvement has been effected by lining the interior with heavy sheet metal; but what is needed for this class of service is a good all-metal car. The long experience with all-metal hopper cars on the Baltimore & Ohio certainly proves their durability.

Small Details.—Cast iron is being superseded by pressed steel and malleable iron; and between the two there is no small rivalry. The pressed steel makers have turned out some work made from too thin plates, while some malleable iron details have been made too thick to secure thorough decarbonization. Pressed steel has been used in England for journal boxes, and a pressed steel journal box is soon to be put on the market here.

Grain doors give no end of trouble because they are so easily ruined at terminals by the recklessness of the men who unload cars by contract. What is needed is a grain door which is indestructible and can be opened when the car is loaded with grain without the use of an axe and crowbar.

PROPOSED LAND SURVEY LAW IN OHIO.

The Ohio Society of Surveyors and Civil Engineers lately appointed Messrs. C. H. Burgess, T. R. Wickenden and C. N. Brown a committee to draft an act for presentation to the Ohio Legislature, having the following ends in view: The examination and registration of land surveyors and the collection and classification of all records of land survey in the state. A somewhat similar act has been annually presented to the Ohio Legislature for the last 13 years by various bodies, but none have yet become law. Various reasons are given for the defeat of

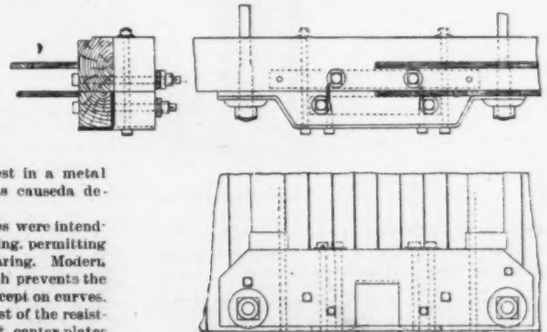


Fig. 3. End Sill and Buffer Block.

these measures up to this time, and the chief reason is one which would prove the urgent need of legislation in this direction. That is, the opposition of the surveyors of the state who are practically incompetent and would lose their occupation under stringent registration and properly applied standards of fitness for office.

The purpose of the proposed law is eminently proper and important in its bearing upon the landed interests of all great states, and in the intended raising of the standard of excellence and accuracy in a class of men and work too long neglected. When the states were young and land cheap it was assumed that almost anyone could be a surveyor, and his "more or less," in reciting the contents of a surveyed tract, was an inconsidered trifle that covered the "factor of personal ignorance" in the individual. The result was a crop of incompetent surveyors, extending up to the present time, and in most states yet untrammeled and uncontrolled by law. While the work of these incompetent men has produced an interminable crop of lawsuits profitable to the lawyers, the lawyer's clients would doubtless welcome a change of practice that would better protect them in the future. It is time this change was made, and in Canada, Pennsylvania, Michigan, Illinois, Colorado and Iowa, the lawmakers have more or less carefully considered the subject of reform in this direction.

The law proposed by the Ohio committee named above seems to cover the essential features of such intended reform and may be outlined as follows:

The Governor of the state is to appoint a State Board of Surveyors, made up of three competent surveyors of not less than 10 continuous years experience in their profession immediately preceding their appointment. They must be reputable citizens of the state, and the professor of civil engineering in the Ohio State University is to be an ex officio member of the Board. The first members of the board are to be appointed for 2, 4 and 6 years, and thereafter one member is to be appointed biennially for 6 years. The members are to take oath of office and enter bonds for $1,000 each. They shall hold stated meetings four times per year at the State Capitol, and special meetings may be held at any other time and place deemed necessary.

Any resident of the state over 21 years of age and of good character may appear before this board for examination and registration, and it shall be the duty of the board to thoroughly and practically examine into the office and field experience of the applicant and as to his knowledge of the sciences and arts pertaining to the correct practice of land surveying as followed in the State of Ohio. The board will issue a certificate to and register such men as are found competent.

The board shall examine instruments, measures and methods used by Ohio land surveyors, and formulate rules and regulations conducing to uniformity of practice among them. The members of the board would receive $5 for every actual day of service, and all necessary expenses, to be paid annually from the fees and penalties established by this law. The surveyors pay $5 each upon applying for examination and $15 for the certificate of registration, valid for five years. They take an oath to faithfully perform their duty, and enter into bonds of $2,000 to the same end. Any person who, besides being of lawful age and good character, shall have been continuously engaged in the practice of land surveying in Ohio for five years, or has graduated from a technical school and has practiced two years continuously, will be entitled to registration as a land surveyor upon satisfactory presentation of his claims, the submission of a bond and the payment of a fee of $20. Provided, such application is made within one year after passage of this act.

It is also made the duty of every Ohio land surveyor to file with the County Surveyor of the county where such surveys is made a complete plot of the same, within 90 days of its execution, according to a form and detail prescribed by the State Board of Surveyors. The land surveyors are to be paid for this record out of the county general fund at the same rate allowed the County Surveyor for transcribing similar plots. The latter officer is to index, classify and preserve these plots after a form prescribed by the State Board.

The placing of monuments of enduring material (see Eng. News, Jan. 9, 1892) at all land corners is made obligatory when accessible. Surveyors must use for purposes of comparison a steel tape not less than 100 ft. long, graduated at intervals of 10, 50 and 66 ft., the exact length of which between such points of graduation has been certified to by the Bureau of Weights and Measures of the U. S. Coast Survey.

One year after the passage of the act it is made unlawful for any public officer in Ohio to make a record for public use of any survey of land lines or subdivision of land into lots, unless the correctness of such plot is certified to by an Ohio land surveyor, county surveyor or his authorized deputy. It is also made unlawful to disturb any monument of an enduring or permanent character placed by the surveyors here designated. The penalties prescribed

for the violation of any of the provisions of this act are fines of not less than $10 nor more than $100; the fines thus collected to be turned over to the State Board of Surveyors to be used in meeting the necessary expenses incurred by the board.

Registered surveyors and their assistants shall not be liable to prosecution for trespass, when performing their duty at any reasonable hour, and they shall be entitled to the same protection as County Surveyors. Registered surveyors shall be entitled to $5.00 per day, in addition to mileage, for all time expended in attendance upon court, etc., when called as expert witnesses. No person shall hereafter be eligible to election as County Surveyor in Ohio unless he shall be, at the time of his election, a registered land surveyor.

THE LAKE HEMET DAM, CALIFORNIA.

In our issue of Jan. 24, 1891, a short notice was given of the high masonry dam being built for the Lake Hemet Water Co. The additional facts given below are from a report to the company recently made by Mr. Jas. D. Schuyler, Consulting Engineer, San Diego, Cal. The dam is about 20 miles east of San Jacinto and 100 miles from San Diego, in the Hemet Valley, at an elevation of 4,200 ft. above the sea.

The capacity of the reservoir formed by the dam, at different levels, has been computed by Mr. Schuyler from surveys made by Mr. C. S. Alverson, as follows:

Height above base of dam.*	Area flooded, acres.	Storage capacity, gallons.	Capacity in miners' ins. for 6 months.
30 ft.	1.03	2,070,750	.85
40 ft.	1.82	10,848,250	4 62
50 ft.	2.71	36 950,625	15.80
60 ft.	24.92	103,238,500	44.20
70 ft.	62 04	251,8.9 250	107.50
80 ft.	104.59	522,412,750	223 20
90 ft.	192.55	908,095,250	388 80
100 ft.	287.42	1,430,762,750	614.00
110 ft.	292.55	2,149,963,250	920.00
120 ft.	428.42	3,092,285,000	1,325 00
130 ft.	485.05	4,427,777,500	1,895.00
140 ft.	600.82	6 216,007,500	2,660.00
150 ft.	738.13	8,418,217,7-0	3,600.00

*The lowest foundations are 13 ft. below base of dam proper.

The survey did not extend above the 150-ft. level, but the capacity of the reservoir with the dam carried to that height is estimated as fully 11,500,000,000 gallons, nearly twice that of the Sweetwater reservoir, and more than that of the reservoir formed by the Bear Valley dam.

In his report, with slight condensation, Mr. Schuyler says:

The present intention of the company is to construct the dam to the height of 150 ft., although I have laid the foundations sufficiently broad to carry the structure 10 ft. higher if desired. The class of masonry of which the dam is being built is certainly the finest I ever saw, and I doubt if it has any superior in America in work of this character. Blocks of granite weighing 5 to 10 tons are set closely together in beds of Portland cement concrete, thoroughly rammed into all joints. When completed it will unquestionably be not only the highest, but the finest dam on the continent. From my observations of the flow of the stream, I have no hesitation in saying that in my opinion the water supply from winter storms is sufficient to fill the reservoir to the height of 160 ft. every year.

In addition to the flood waters of winter, the summer showers of July and August will furnish no inconsiderable volume. My observation of several of these showers, which were of almost daily occurrence for several weeks, was that for an hour or two the stream would flow at the rate of 250,000,000 to 300,000,000 gallons daily, diminishing to the normal low water flow of about 3,000,000 gallons daily, in 15 to 20 hours. I think the reservoir would receive an addition of 50,000,000 to 150,000,000 gallons from each of these showers, and sometimes considerably more. This source of summer supply, which is a resource peculiar to the Southern California mountain region, is likely to afford an effective increase in the duty of the reservoir of 10 to 15%. The constant flow of the stream in summer is more than sufficient to offset the loss by evaporation on the surface of the lake.

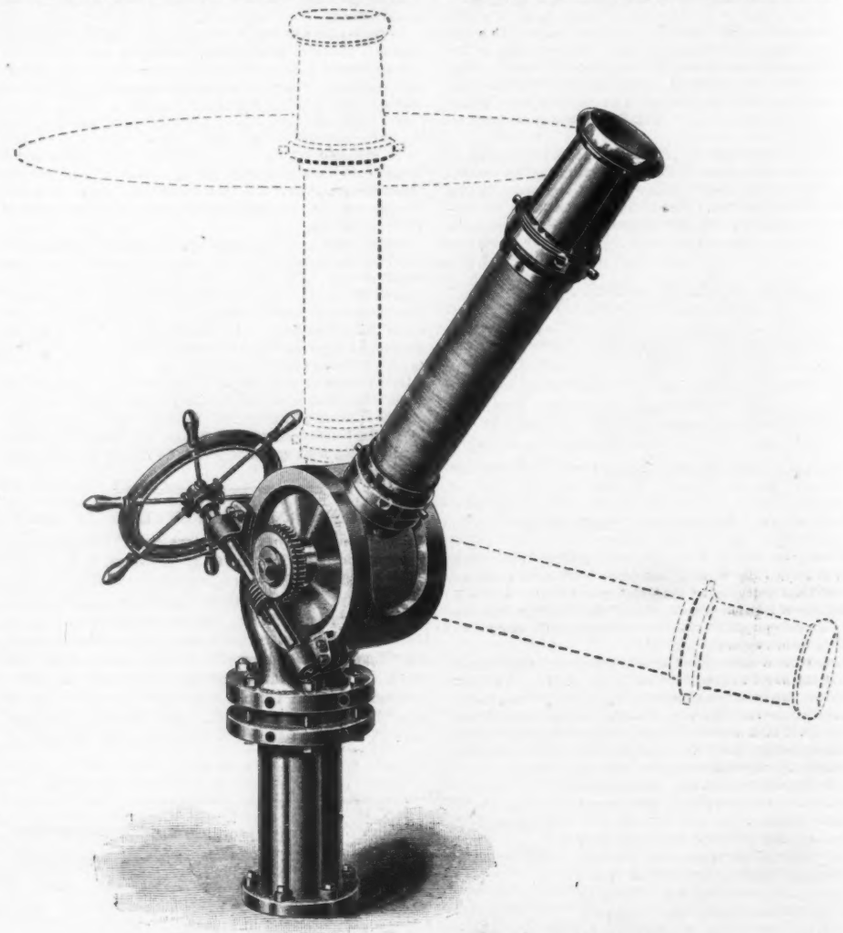
As the area of dry lands in the valley requiring water is greater than any possible supply available, it seems to be a profitable and safe proposition to carry the dam to its utmost limit of height. It is possible to go still higher than 160 ft., but not advisable, on account of the necessity of building a considerable length of auxiliary dam in the gap in the ridge south of the main dam, the lowest point in which is 133 ft. above base.

The masonry has now reached a height of 38 ft. above base, or about 46 ft. above the lowest bottom. The organization is fully effected and working smoothly, the plant is complete and operating successfully as planned, and with reasonably good luck the structure can be completed to the 150-ft. level in a year from this time.

The thickness of the dam at the extreme bottom is about 100 ft., which is greater than its length, or the width between cañon walls at the height of 50 ft., dimensions which have no parallel for stability among dams in the known world.

THE MONITOR 5½-IN. FIRE NOZZLE.

The cut here given shows a fire nozzle lately made for a fire boat in the service of the Fire Department of the city of New York, by Andrew J. Morse & Son, of Boston, Mass. A nozzle previously made for a fire boat by the same firm was capable of throwing a 3-in. stream, but the one here illustrated threw a 5½-in. stream, at its official trial, a distance of 280 to 290 ft. The nozzle has a range extending from the perpendicular to 10° below the horizontal,



THE MONITOR 5 1-2-IN. FIRE NOZZLE.

and rotates upon its base in a complete circle. The method of manipulation is sufficiently well shown in the cut without further description.

THE ONE-CLASS SYSTEM OF PASSENGER TRAFFIC FOR ENGLISH RAILWAYS.

The following article from the "Railway Press," of London, England, is of interest from the fact that it looks ahead of the present gradual elimination of one of the three classes of passenger accommodation on English railways, and points out the advantages of the one-class system, especially in connection with the American type of the car, the introduction of which is recommended. Should such a general reform be instituted, it would probably follow the American system of having one general class, with parlor cars, for which an extra charge is made, independent of the regular fare. We have in former articles shown the development of modern passenger rolling stock in England, with the introduction of parlor, sleeping and dining cars, the providing of lavatory accommodation, and the use of long cars on trucks or "bogies." The Midland Railway, which is specially referred to, abandoned the second-class some years ago, and has now only first-class and third class ordinary cars. (Eng. News, May 9, 1891.)

At last there seems some probability of the one-class policy advocated consistently by this journal being permitted a trial. It is generally believed that the Midland Ry. is seriously entertaining the question of abolishing one of its two classes. There can hardly be two opinions that if the company has the courage of its convictions the results will be greatly to the advantage of the shareholders and the public alike. It is evident that, however the operations may be described, it is the third class that will be abolished. The third-class carriages would be fitted up as first-class, the expense of which change is exceedingly small and the carriages used indiscriminately.

Of the Midland passengers, 96½% would have the advantage of immensely superior accommodation at the same fares as now, the remaining 3½% traveling just as they are doing for about five eighths the money. All would be saved the worry and trouble of running up and down the train to get a seat, etc. The benefit to the public is as clear as the noon-day sun. The number of travelers on the Midland Ry. within 12 months of the adoption of the system would probably be doubled. The gain to the company is not less certain, though it is not so immediately transparent. We do not mean the gain on account of the extra business that would ensue, but gain on the traffic as at present existing.

It must be borne in mind that the percentage of persons traveling first-class is very small indeed. During the first half of the present year the numbers on the Midland Ry. were 631,468 first-class to 16,928,757 third, or as 1 to 27 nearly. The amount earned from the first-class was £109,606, and from the third-class £775,746. Now the third-class fare on this line is five-eighths of the first. Therefore if the first-class passengers had traveled third-class the company would have received the same amount less three-eighths of £109,606, or the bagatelle of £41,136, about £80,000 a year.

It is transparent that this sum, half a week's takings, would be saved many times over in the simpler and less expensive arrangements the change would make possible. General managers are in the habit of speaking of first-class traffic as just paying itself, but they forget that an immense amount of expenditure is incurred solely in the interests of the handful of first-class passengers. Take the magnificent Midland station for instance. A tenth part of the money spent upon it would have given the

third-class passenger better accommodation than they now get. It is just the same with employees, the wages of many of them ought to be debited to the first class.

Probably the change, if decided on, will be made in the first instance as indicated, but eventually we think the long American type of carriage will have to be adopted When once the absurdity of the three classes is seen through, the inconvenience of the compartment system is apparent. It would be too expensive to sell off the old stock, representing some millions of capital, but no more old-fashioned carriages ought to be built. A certain number of American cars should be constructed yearly, till in course of time they had entirely displaced the obsolete type. The Great Northern Ry. has also entered on a two-class policy, so our efforts in the cause of reform, however disheartening may have been the results, have not been altogether in vain.

The Chicago & St. Louis Electric Ry. Co. was incorporated at Springfield, Ill., Jan. 21, with $1,000,000 capital stock. This company proposes to build and operate an electric railway between the cities named in its title. The incorporators are Messrs. S. B. McBurney and A. H. Cooper, of St. Louis, and W. E. Beckwith, Thos. May, Jr., and E. C. Rhoades, of East St. Louis. The press gossip concerning this road is to the effect that it will be located on a direct line between the two cities, with "no curves and few cuts and fills." The speed expected by its promoters is 150 miles per hour, operating under the electric highway patents of Dr. Arthur Wellington Adams. Each electric carriage is to have two pairs of 6-ft. driving wheels, each pair driven by separate electric motors and making 500 revolutions per minute. The top of the car is to be only 9 ft. above the rail and is provided with a wedge-shaped front, for reducing air resistance and keeping the car down on the rails. The weight of each car and motor is to be 10 tons. Provisions are to be made for showing strong electric lights and ringing bells two minutes before grade crossings are reached by the train. The whole line is to be operated from one central station, near the coal mines of Clinton, Ill.

The shortest railway in England worked by an independent company, and doing a general passenger and freight business, is said to be the Easingwold line, running between the Northeastern Ry. and the town of Easingwold, a distance of 2½ miles. It cost about $80,000, and the average revenue from all sources is about $150 per week, or $7,800 per year. The shortest American railway of which we have knowledge is the New York Central, Hudson River & Fort Orange Ry., which is 0.6 mile long. This road, though built as an independent line between Castleton and Schodack, N. Y., is now leased by the New York Central, but it has its own full board of officers. The road, with equipment, cost $5,000, and the net earnings for 1891 were $312.68. The shortest line in this country, but used for passenger traffic only, and therefore differing from the two above mentioned, is the Marine Railway, running between Manhattan Beach and Brighton Beach at Coney Island, N. Y. It is a double track line 0.328 mile long, and is operated on the shuttle system by two trains, each running to and fro on its own track. It is only operated during the summer, but has a large traffic, being the only means of access between the two points. There is a uniform fare of 5 cts., or at the rate of about 15 cts. per mile, and the number of passengers during the year ending June 30, 1890, was 432,496. The net surplus for that year was $30,358. The line is owned by an independent company, but is in the interest of the Long Island R. R. Co. It has 2 Mason tank engines and 4 open cars with transverse seats. The engines are of the Fairlie type, with a leading pony truck, four driving wheels in a steam truck, and a six-wheel truck under the rear tank.

A wrought metal car coupling of the M. C. B. type is the subject of patents issued Jan. 19 to Mr. E. W. Mackenzie-Hughes, Chief Engineer of the Fox Solid Pressed Steel Co., of Chicago. The shank of the coupler is made of a solid wrought tube, which screws into a projection on the rear of the coupling head. In another patent a single tube forms both head and shank, being split, flared and shaped to form the wall of the coupler head. Progress in this direction is of great interest. The company inform us, however, that they do not intend to put the coupler on the market at present.

An electric train signal, for intercommunication between the passengers, conductor and engine driver, has been tried on the North British Ry., Scotland, as a substitute for the ordinary communication bell cord. The apparatus is described as follows by the "Practical Engineer," London. An electric bell, with dry battery attached, is fitted onto the engine and in each guard's van. These bells are connected by two trunk wires, positive and negative, which are carried throughout the length of the train, while two branch wires, one from each trunk wire, are led into each compartment, and terminate in an electric push placed under the parcel rack, and protected by a metal cap with a small circular pane of glass in front of it, which the passenger breaks in order to press the alarm push, the glass being specially prepared so as not to injure the hand of the person breaking it. At the end of each carriage there are two electrically worked semaphore signals fixed one on either side, close to the cornice molding, and connected with the several pushes, so that when an alarm is given from any compartment the signals, which are covered with luminous paint, on the carriage in which the alarm has been sounded drop down, and thus attract attention.

The heavy rails in use in the track of the Prussian and other railways are thus tabulated in "Glaser's Annalen," the lengths given for several American rails (39.3 ft.) being certainly wrong, as there are only a few experimental rails longer than 30 ft. in use in this continent. The rest of the table we presume is correct.

Name.	Width of Head, ins.	Width of Web, ins.	Width of Ft. ins.	Height, ins.	Weight per yard, lbs.	Length of rail, ft.	No. ties per rail.
Goliath	2 3/32	3/4	5 1/16	5 1/32	105.	29.4	12
Paris, Lyons & Mediterranean (1889)	2 1/32	7/16	5 3/8	5 1/32	94.7	39.3	15-16
French Nor'n Ry (1888)	2 3/8	1/2	5 3/32	5 1/32	87.	39.3	14
French East'n. Ry. (1889)	2 3/8	17/32	5 1/32	5 1/16	89.	39.3	16
Austrian State Ry. (1891)	2 3/8	33/64	4 33/64	5 1/32	86.7	32.7 / 49.2	13 / 14
Dutch State Rys. (1884)	2 3/8	1/2	4 1/32	5 1/32	80.6	29.3	14
Phila. & Read. (1888)	2 3/8	1/2	5.	5.	90.	39.3	15-16
Penna. (1887)	2 7/16	17/32	5.	5.	85.	39.3	15-16
N. Y. Central (1887)	2 7/16	1/2	4 1/2	5.	80.	39.3	15-16
Boston & Albany (1891).	Top, 2 3/32 / Bott. 3.00	5/8	5 1/16	5.	95.8	.....	.....
Prussian Gov. Rys. (1885)	2 3/32	7/16	4 1/4	5 5/32	67.3	29.4	11
" (1890)	2 5/32	7/16	4 1/2	5 1/16	82.6	29.4	11

Rain making experiments, says "Indian Engineering," are being extensively carried out in India, somewhat on the same lines as adopted by our own government expedition to Texas. In Upper Burma the explosion of 10 to 50-lb. charges of dynamite by Lieut. Pitcher, R. E., is said to have resulted in a steady downpour on the following day, and the experiments are to be continued. At Bellary, 2½-lb. charges of dynamite were attached to bamboos 14 ft. high and 6 ft. apart, in 20 rows of 8 charges each. No rain, however, followed the explosion.

The cars of the electric elevated railway at Liverpool, England, are to be 45 ft. long, 8 ft. 6 ins. wide, and carried upon four-wheel trucks. They will have a middle passageway from end to end on the American plan, but will be divided into two third-class compartments for 20 passengers each, one first-class for 16 passengers and an end compartment for the driver, with side doors to each compartment. It would seem more reasonable to style these compartments first and second class, rather than first and third. The weight will be about 14 tons, including the motors. The firm of Brown, Marshall & Co., of Saltley, will build 30 of these cars, and the motors will be supplied by the Electrical Construction Co., of Wolverhampton. The line is about 6½ miles long, with 13 stations, and there will be uniform fares of 4 cts. for third class and 6 cts. for first class. This railway was described in our issue of Sept. 5, 1891.

Tests with a new paint the name of which we can only give in German: (Schuppenpanzerfarbe (schuppen = scales; panzer = coat of mail; called so from its metallic gray color, we presume, and possibly because it is an iron ore paint) were recently made by the Government testing plant at Berlin-Charlottenburg, and are thus reported in the "Centralblatt der Bauverwaltung." The comparative merits of red lead and Schuppenpanzer paint were ascertained in regard to the following points:

1. Thickness of coat of paint.
2. Time required for drying.
3. Covering of rust-spots, and
4. Elasticity of coat of paint.

The red lead ran so freely that parts of it had to be taken off with a brush from the lower edge of the freshly painted strip of sheet iron, while with the Schuppenpanzer paint no running or dripping was observed.

Composition of paints.	Thickness of coat of paint. Quantity of paint necessary to cover 10.76 sq. ft. One coat, oz.	Thickness of coat of paint. Quantity of paint necessary to cover 10.76 sq. ft. Two coats, oz.	Time required for drying. Atmospheric conditions. Temperature °C.	Time required for drying. Atmospheric conditions. Moisture of atmosphere, %	Time required for drying. Average time required for drying. Min.
3.5 oz. red lead / 0.4 oz. varnish	6.5	12.4	20-20.5	67-72	455.
3.5 oz. Schuppenpanzer paint / 1. oz. varnish	1.5	2.5	20-20.5	67-72	370.
3.5 oz. Schuppenpanzer paint / 0.9 oz. ozonized linseed-oil varnish (Dr. Graf's, boiled 3 times)	0.9	1.6	20-22.5	65-68	125.

The above table gives the approximate quantities and time required for the drying of the paint. The Schuppenpanzer paint dries slower, if siccative is added.

The dried paints were also tested as to their resistance against the influence of salt water and moist air charged with carbonic acid. The painted sheets of iron used in the tests were bent around pins of from ½ in. to ⅜ in. diam. During this procedure the scale on the surface of the sheets, which during the rolling process is formed in layers, burst, showing fine fissures through which the rust easily penetrated. With the red lead this rust could not be detected from the surface, while with the Schuppenpanzer paint it could be easily detected by the changed color of the paint above any rusting. Furthermore it was found that one coat of the latter paint is by farthe more

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WEATHER REPORTS OF VARIOUS AMERICAN CITIES FOR THE MONTH OF DECEMBER, 1891.

[Furnished to Engineering News by the Department of Agriculture.]

	Station.	Temperature, (Deg. Fah.) Average	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average	Max	Direction at time of max. velocity.	Precipitation—Rain and melted snow.—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	30.6	54	—4	58	10.6	48	S	2.63	0.99	11
	Portland, Me.	35.6	56	8	48	2.5	48	SE	4.17	1.30	12
	New York City	41.8	68	14	54	13.5	53	NW	3.30	0.86	10
	Pittsburg, Pa.	42.1	63	16	47	6.9	28	NW	3.05	1.01	12
	Chicago, Ill.	35.4	57	9	48	21.4	57	SE	1.32	0.56	9
	Omaha, Neb.	34.8	60	2	58	8.5	30	NW	2.07	1.06	9
	St. Paul, Minn.	27.6	53	—8	61	6.7	28	SW	2.87	1.50	11
	Duluth, Minn.	26.9	54	—8	62	7.3	38	NW	3.76	1.84	12
	Bismarck, N. Dak.	19.6	46	—22	68	9.9	42	NW	0.44	0.22	5
	Average	32.9	56.8	0.8	56.0	10.5	41.3	.....	2.62	1.02	10
Southern Cities.	Washington City	43.0	67	15	52	6.0	35	NW	2.80	0.97	8
	Louisville, Ky.	44.6	65	21	44	8.2	37	SW	3.65	1.18	10
	St. Louis, Mo.	42.8	64	14	50	13.5	45	SW	1.32	0.99	8
	Savannah, Ga.	55.4	77	27	50	7.4	33	W	1.26	0.31	14
	Leavenworth, Kan.	39.3	64	10	54	8.1	28	NW	1.71	0.63	7
	Jacksonville, Fla.	59.6	80	32	48	7.2	30	NE	3.46	1.77	14
	Chattanooga, Tenn.	45.6	64	21	43	5.5	36	S	5.38	2.04	11
	New Orleans, La.	55.9	78	36	42	9.6	38	SW	3.93	2.57	12
	Memphis, Tenn.	49.2	71	27	44	8.6	36	NW	6.50	3.53	9
	Palestine, Tex.	52.2	78	26	50	8.4	32	W	4.65	1.38	8
	Average	48.8	70.6	22.9	47.7	8.2	35.1	.....	3.47	1.53	10
Western Cities.	Helena, Mont.	28.5	47	—6	55	8.5	41	SW	0.40	0.15	10
	Port Angeles, Wash.	39.7	58	28	30	5.2	40	SW	8.95	1.97	20
	San Francisco, Cal.	49.6	64	37	27	6.4	31	SW	5.62	2.21	18
	Salt Lake City, Utah.	28.6	51	0	51	5.9	35	SW	2.19	0.42	15
	Denver, Colo.	31.0	65	—4	69	8.0	36	NW	1.56	0.62	8
	Yuma, Ariz.	51.3	77	25	52	7.3	38	W	0.05	0.05	1
	Santa Fé, N. Mex.	25.6	52	—1	53	8.9	37	NE	1.54	0.71	7
	Average	36.3	59.1	11.0	48.1	7.0	37.7	.....	2.90	0.88	11

elastic of the two, is 12 times lighter, dries about 2½ times as fast, and is 6 times cheaper than two coats of red lead.

We will try to ascertain and state in a later issue the components and nature of this undescribed paint.

The pneumatic electric block signal system of the Union Switch & Signal Co. was installed two years ago on the Central Railroad of New Jersey between Jersey City, the terminus, and Bergen Point, about 7 miles. The contract has now been let for extending the system to Bound Brook, which will make 32 miles covered by the system. It is this section of the line on which the greatest number of passenger trains are run, as the road carries a heavy suburban traffic. The blocks from Elizabeth to Bound Brook, 18½ miles will be one half mile in length. It is stated that the compressed air pipes which distributed air to the switches and signals will also furnish air to work the draw-span of the bridge across Newark Bay, which is at present turned by steam power. The Hastings accident seems destined to give as great an impetus to the introduction of the block system as the White River holocaust of 1887 did toward the use of safer methods of car heating. Both accidents awakened the men who control the purse strings to the necessity of action, and it is usually these men rather than the operating officers who oppose the introduction of improvements.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

KATSKILL MT. INCLINE.—It is stated that the contracts have been completed for building the proposed incline railway from Palenville, N. Y., to the Katskill Mountain House, about 7,000 ft. The elevation to be overcome is about 1,800 ft. The contractors for the grading and masonry are Pennell & O'Hern, for the timber work Chas. Buckle, New York City, and for the machinery, Otis Bros. & Co., New York City. Thos. E. Brown, Jr., New York City, is the Chief Engineer.

PITTSBURG, OHIO VALLEY & CINCINNATI.—About 13 miles of track have now been laid on this line from Bellaire to Powhatan, O., 15 miles, and the track will soon be completed to the latter place.

LANCASTER, OXFORD & SOUTHERN.—Contracts will probably be let the coming season for building this railway from Quarryville, Pa., to Singerly, Md., 23 miles. S. C. Slaymaker, Ch. Engr., Lancaster, Pa.

CHESAPEAKE & OHIO.—According to a statement made by one of the officers of this company, about 65 miles of second track will be laid on the mountain divisions of its lines during the coming season.

COLUMBUS, HOCKING VALLEY & TOLEDO.—This company will replace all the iron bridges on its line between Columbus & Nelsonville, O., with heavier structures. Bids for their construction will soon be received.

MAINE CENTRAL.—The double tracking from Gardiner to Augusta, Me., is nearly completed. It is reported that it will be extended the coming season.

EMPORIUM & RICH VALLEY.—Josiah Howard, of Emporium, Pa., writes us as follows:

"This road will run from Emporium, Pa., via Fairview, Lewis Run and Elk Springs to the county line, about 10 or 12 miles. The surveys have been completed and seven miles of the road are in operation. It is expected to have the remainder of the line in operation by July 1, 1892, after which it is possible that a further extension to Clermont, Pa., will be made. E. H. Welch, of Emporium, Pa., is Chief Engineer and P. Fitzpatrick, of Emporium, Pa., is the contractor.

Projects and Surveys.

NEW YORK, NEW LONDON & NORWICH TRANSPORTATION CO.—A press dispatch says: "The New York, New London & Norwich Transportation Co. has been incorporated in Maine with a capital of $800,000. Railroad men consider it a move on the part of the New York & New England to get a New York terminus, and that the 'Transportation Company' means big ferry-boats upon which whole trains may be taken from New London, Conn., to Greenport, L. I., thence over the Long Island road to Brooklyn."

Southern.—Existing Roads.

NORFOLK & WESTERN.—It is stated that this company has leased the Lynchburg & Durham R. R., running from Lynchburg, Va., to Durham, N. C., 114 miles, and will build a short connection to its lines at Lynchburg.—Work is stated to be making rapid progress on the Ohio Extension east from Dunlow, Va.

TENNESSEE MIDLAND.—There is a probability that steps will soon be taken toward the extension of this Tennessee road east to Nashville.

CHARLESTON, SUMTER & NORTHERN.—Chas. E. Kimball, of New York, has been appointed receiver of this railway, on the petition of A. A. Howlett. It is stated that the receiver will ask for a decree for the sale of the road and that the company will be reorganized.

TALLAPOOSA LUMBER, MFG. & R. R. CO.—Construction has been begun on this company's 24-mile railway.

TUSCALOOSA COAL & IRON CO.—L. F. Bellinger writes us that he is not the Chief Engineer of this company, as stated in our issue of Dec. 19, 1891.

RICHMOND & DANVILLE.—The Elberton Air Line R. R., running from Elberton to Toccoa, Ga., 50 miles, will, it is stated, be changed to standard gage in the spring. John H. Jones, Elberton, Ga., Pres.

BALTIMORE & OHIO.—It is stated that work will begin soon on the proposed second track from Grafton to Wheeling, W. Va., 100 miles.

Projects and Surveys.

SUWANNEE & GULF.—Chas. P. Turner, 6 Alabama St., Atlanta, Ga., Ch. Engr., writes us as follows:

"This road is projected in the interest of the Suwannee River Phosphate Co., and will run from Bronson to Luraville, Fla., 52 miles. The road runs through a level country and its principal business will be in lumber and phosphate. All of the right of way has been obtained and donations of land and money secured. The work will be done by the company and by local contractors. It is expected to have the road in operation by March or April, 1892."

NORFOLK, WILMINGTON & CHARLESTON.—Two corps of engineers are now at work on the preliminary survey for this road; one south from Norfolk, Va., and the other north from Charleston, S. C. The road is projected to run from Norfolk, Va., to Charleston, S. C., 350 miles, with a branch to Columbia, S. C. F. L. Pitman, Philadelphia, Pa., Ch. Engr.

NEW YORK CONSTRUCTION CO.—Chartered in Florida to build railways, bridges, etc., with a capital stock of $150,000. Among the incorporators are: John O. Bronson, Albert Mathews and W. W. Walker.

SHELBYVILLE, NASHVILLE & NORTHERN.—The preliminary survey for this line from Shelbyville to Nashville Tenn., 50 miles, has been completed. The people along the route are reported to favor the construction of the road and a very favorable line has been secured.

CHARLESTON, CLENDENNIN & SOUTHERN.—The engineers have begun the location of the section of this line from Charleston, W. Va., to the Clay Co. line, for the construction of which bids are asked. The survey will probably be continued to Sutton, W. Va.

HINTON & NEW RIVER.—The organization of this company has been completed and the directors have decided to begin the surveys for the line at once. The road is projected to run from Hinton, W. Va., on the Chesapeake & Ohio Ry. to the mouth of East River, 36 miles. Jas. H. Miller, Hinton, W. Va.

MARION & RYE VALLEY.—W. C. Foster, 52 Broadway, New York City, Ch. Engr., writes us as follows:

"The preliminary survey has been completed for this railway from Marion, W. Va., to the headwaters of Staley's Creek and thence into and along Rye Valley, a total distance of 50 miles, and the locating surveys are well under way. Only 7 miles of the line will be built at present. The route is through a mountainous country. The maximum grade is 2% and the maximum curve is 18°. The road is projected to develop the mining and timber lands along its route."

VIRGINIA.—A bill has been introduced in the legislature to incorporate the Atlantic, Staunton & West Virginia Ry. Co., with Henry Hutchinson, O. K. Lapham, J. W. Bodley, Reeves Catt, E. C. Vincent and others as incorporators. The company is authorized to build a railroad from some point on the York or Potomac River near the Chesapeake Bay to Staunton, Va., and from there to any point on the West Virginia line. The maximum capital stock is $15,000,000. A bill has been introduced in the legislature to charter the Berkley & South Mills R. R. Co., to build a railroad from Berkley or some point on the Southern branch of the Elizabeth River to South Mills, N. C., or some point in North Carolina. This is probably the Norfolk & South Mills R. R., reported in last issue as applying to the legislature for a charter. A. B. Bowman, J. C. Langhorne, T. M. Starkey, George W. Palmer, J. W. Berry and others are the corporators of the Salem & Southern Railway Co., reported in last issue as applying to the legislature for a charter. The Chesapeake & West Virginia R. R. Co. noted in our last issue is the Chesapeake, Shendun & Western R. R. Co. The road is to extend from a point between the Potomac and York rivers to some point on the West Virginia State line. The capital stock is $10,000,000. Jed Hotchkiss, of Shendun, Va., can be addressed.

Northwest.—Existing Roads.

WISCONSIN CENTRAL.—This company will probably build a cut-off from Marshfield to Bateman, Wis. The right of way has been secured.

GREAT NORTHWEST CENTRAL.—It is stated that a branch will be built to Carberry, Man., during the coming season.

CHICAGO, FT. MADISON & DES MOINES.—An official of this road is reported as saying that work will be begun immediately on an extension from Libertyville to Ottumwa, Ia., 22 miles.

NORTHERN PACIFIC.—The main line between Brainard and Duluth, Minn., will be relaid with 65-lb steel rail, and improvements will be made in the roadbed.

BURLINGTON & MISSOURI RIVER.—The Frenchman's Valley Branch has been completed from Beverly to Wauntea, Neb.

WINONA & SOUTHWESTERN.—An official of this company states that the road will be extended beyond Mason City, Ia., this season, but the route of the extension has not been decided upon.

Projects and Surveys.

OTTUMWA & FREMONT.—A syndicate of Ottumwa capitalists propose to build a railway from Ottumwa to Fremont, Ia., about 18 miles.

MANKATO & NORTHWESTERN.—The officers of this company, which proposes to build a railway from Mankato to Farmington, Minn., are: Pres., P. H. Carney; V. P., J. D. Nilger; Sec., J. G. Fowler, and Treas., D. L. Rose, all of Mankato.

Southwest.—Existing Roads.

VELASCO TERMINAL.—A press dispatch states that this line has been completed from Velasco to Chenango, Tex., 21 miles. About 13 miles of the track were laid this year.

CHOCTAW COAL & RY. CO.—The extension to Oklahoma City, Ind. Ter., was completed to within two miles of that place on Jan. 22, and it is probably completed by this time. About 11 miles of track have been laid since Jan. 1.

PAN AMERICAN.—Grading is slowly progressing on this line from Victoria to Brownsville, Tex. A press dispatch says: "From Mr. Kelly of the engineer corps, it is learned that the graders on the Pan-American line have completed about five miles and have 50 teams at work. The surveying corps have completed the permanent location of the line to the Guadaloupe River and moved camp to the San Antonio River to-day. The preliminary survey was completed to Brownsville some time since. It is understood that the contract for a large quantity of bridge timbers has been let. They are to be cut in the Guadaloupe River bottom in which a splendid quality of white oak is found. The iron is expected to begin moving in very soon."

KANSAS CITY, WATKINS & GULF.—It is stated that this line will be completed to Alexandria, La., by March 1.

CLEVELAND, ST. LOUIS & KANSAS CITY.—It is stated that the Cleveland, St. Louis & Kansas City R. R., which was recently sold to St. Louis capitalists, is to be completed to Boonville at once, and within a short time to Kansas City, Mo. The only portion of the line at present completed is from St. Charles to Hamburg, Mo., only 16 miles, but nearly 60 miles more have been graded, some 36 miles on the west end of the completed portion, extending west from Hamburg, and the balance from St. Charles. The intention of the new company is to cross the Missouri River at some point between St. Charles and the mouth of the river, and enter St. Louis on the Merchants' Terminal's tracks. From Hamburg the line will run along the north shore of the Missouri River to Boonville, Mo., following the river the entire distance. At Boonville the river will be crossed and the road will then take almost a direct line to Kansas City. A new charter will have to be obtained, but no trouble is anticipated in regard to that. The old charter might be purchased, but the company's debts would have to be accepted with it, and hence it will be much cheaper to get a new charter. The old company sold bonds to the amount of $650,000, receiving 75 cts. on the dollar for them, but they were unable to raise any more money and had to abandon the work. The contractors then took possession of as much of the road as had been graded and organized themselves into the American Construction Co. This company has ever since been operating the 16 miles of the line between St. Charles and Hamburg. Under the terms of the option the American Construction Co. is to be given the contract of completing both ends of the line—to St. Louis and to Kansas City. The new railroad company is to pay for the construction in 20-mile sections, and the money is to be raised by the sale of bonds, $20,000 to the mile.

Projects and Surveys.

TRINITY, CAMERON & WESTERN.—At a meeting of the directors of this company held on Jan. 12, the following officers were elected: Pres., John M. Hefley; V.-P., N. S. Walton; Gen. Man., R. Lyles; Secy., M. J. Moore. The proposed road is to run from Trinity to Granger, Tex., 100 miles, and a preliminary survey has been made. It is proposed to charter the company at once and begin the preliminary work toward the construction of the road.

QUANAH & OKLAHOMA.—This railway, noted in our last issue, is projected to run from Ft. Worth, Tex., to Quanah, El Reno and Guthrie, Ind. Ter., to the Kansas line. Among the incorporators are: G. M. Dodge and others.

Rocky Mt. and Pacific.—Existing Roads.

BELLINGHAM BAY & EASTERN.—All arrangements have been completed for building this road to the Blue Canyon coal mines near Whatcom, Wash. The contract has been let to A. L. McCoy & Co., the work to be completed by June 1. Contracts for the coal bunkers will be let soon. Ch. Engr., J. J. Donovan, Whatcom, Wash.

RIO GRANDE SOUTHERN.—Reports are in circulation that this Colorado road will be extended during the coming season, to connect with the Southern Pacific line in New Mexico.

TEXAS & PACIFIC.—A rumor, with apparently very little substance to it, is in circulation, that this road will be extended to Guaymas, Mexico, on the Pacific coast.

COLORADO MIDLAND.—There is a prospect that this company will build a branch to the Cripple Creek mining district in Colorado.

NORTHERN PACIFIC.—Only about 10 miles of grading remain to be finished on the line from Chehalis to South Bend, Wash.

Foreign.

MEXICAN INTERNATIONAL.—Tracklaying on this extension of this line from Torreon to Durango, Mex., began Jan. 1, 1892, and it is expected that the road will be completed to Pedro Seña by March 1. In a recent interview V.-P. C. F. Croker, of the Southern Pacific Co., said: "This is the most important project that we have had under consideration of late years. The distance from Torreon to Durango is 156 miles, which, with our other track, would give us over 650 miles of railroad in Mexican territory, for, with the short auxiliary running from the Mexican International, we already have about 500 miles of road in that country. The road from Torreon to Durango will not be very expensive to construct, except in certain places where the country is rather rough. For the greater portion the surface is of a rolling nature. It is a rich country, there being some very good mines in it, while not a little of the soil is cultivable."

MEXICO, CUERNAVACA & PACIFIC.—At a meeting of the Mexico, Cuernavaca & Pacific Ry. Construction Co. in the City of Mexico recently the following officers were elected: Pres., Philip Zang, of Denver, Colo.; 1st V.-P. and Gen. Man., Gen. Herman Sturm, of Indianapolis; Asst. Gen. Man., and 2nd. V.-P., J. E. Hampson; Treas., A. H. Heath, of Denver; Sec., Charles Wheeler, of Denver. It was voted that the work be pushed on the city belt and the main line as far as Cuernavaca. The Chief Engineer of the two roads was also instructed to close the contract for the entire road from the City of Mexico to Palizada Bay, the Pacific terminal of the line, the work to be completed to Cuernavaca by Jan. 1, 1893.

ELECTRIC RAILWAYS.

HARRISBURG, PA.—The Citizens' Passenger Ry. Co. will build a line to Oberlin, 6 miles, and work will be commenced shortly. Pres., J. A. Dunkle.

BALTIMORE, MD.—The Union Passenger Ry. Co. has applied for power to adopt an overhead wire electric system.

ROME, GA.—The Thomson-Houston Co. has a contract for a line 6 miles long.

WILMINGTON, N. C.—The Wilmington Electric Street Ry. Co. has purchased the street railway and also a site for the power-house, work on which will be commenced in the spring. The track will be relaid with 45-lb. girder rails and the contract for the overhead wire construction has been let to J. S. White, of New York. Pres., E. L. Hawks, Winston, N. C.; Vice-Pres. and Gen. Man., J. H. Barnard, Asheville, N. C.; Secy., B. F. O'Connor, New York, N. Y.

COLUMBUS, MISS.—The Columbus Street Railway & Power Co. has let the contract for building its railway, which will be used for freight and passenger traffic. Work will be commenced as soon as the material can be purchased. Mr. N. M. Brandon, of Meridian, Miss., is Chief Engineer, and will have charge of the work.

NEW COMPANIES.—City Electric Ry. Co., Decatur, Ill., $300,000; D. S. Shellaberger, James Milliken and W. H. Starr. Citizens' Electric Passenger Ry. Co., Steelton, Pa., $100,000; Pres., J. A. Dunkel.—Lancaster & New Holland Electric Ry. Co., Lancaster, Pa., $150,000; Pres. C. A. Fondersmith.—Connellsville Electric Ry. Co., Connellsville, Pa., $100,000; Pres., J. M. Reid. Lancaster.—Chicago & St. Louis Electric Ry. Co., East St. Louis, Ill., $1,000,000; S. B. McBurney and A. H. Carper, St. Louis, Mo., W. E. Beckwith, Thomas May and S. C. Rhoades, East St. Louis, Ill.

ELEVATED RAILWAY.

PHILADELPHIA, PA.—The ordinance authorizing the construction by the Quaker City Elevated Ry. Co. of an elevated line on Market St. and Ridge, Lancaster, and Woodland Aves., has been passed by the Council.

HIGHWAYS.

PENNSYLVANIA.—An election is to be held in Nether Providence township on the issue of $65,000 road bonds.

VIRGINIA.—Dinwiddie Co. has voted in favor of the issue of bonds by the supervisors, not to exceed $100,000, for the permanent improvement of the three main highways of the county.

OREGON.—The Salem Board of Trade has taken up the matter of providing better roads for Marion Co. Petitions are being signed in all parts of the county, urging the court to levy a 2-mill tax to build good gravel roads under contract.

BRIDGES, TUNNELS AND CANALS.

ALBANY, N. Y.—A bill has been introduced into the New York Assembly for the bridge across the Hudson River at this point, noted last week. It is to be a drawbridge 20 ft. above water. The capital stock is $300,000. Among those interested are T. W. Cantwell and C. P. Williams, of Albany.

LOGAN CO., O.—Christie Williams, Co. Aud., Bellefontaine, O., will receive bids until Feb. 9 for building an iron bridge, 60 ft. span and two 14-ft. approaches.

LEAVENWORTH, KAN.—The Leavenworth & Missouri Bridge Co., asks Congress for permission to build a bridge over the Missouri River at this place.

LAVACA CO., TEX.—Bids will be received until Feb. 8 for building an iron bridge over Smother's Creek. John Buchanan, Hallettsville, Tex.

PUEBLO, COLO.—Bids will be received until Feb. 15 for building an iron and steel bridge across Fountain River; span, 160 ft; 30-ft. roadway, two 6-ft. sidewalks. A. G. Elder, Cy. Engr.

WATER-WORKS.

New England.

BERLIN AND BERLIN FALLS, N. H.—The Berlin Aqueduct Co. has made a proposition to the town of Berlin to supply these two villages with water. The proposed contract provides for not less than 40 hydrants at an annual rental of $50 each to and including the year 1915. John Hayes and others, W. Wks. Com.

HOOKSET, N. H.—It is reported that works will be built by Towle & Lantry. A pumping engine will take the place of the present windmill and mains will be laid.

ARLINGTON, MASS.—W. W. Ranson, John T. White and five others have just been appointed by the town to report on an increased and improved water supply.

BROCKTON, MASS.—The Mayor has been authorized to petition the legislature for authority to issue $100,000 additional water bonds.

BOSTON, MASS.—Preliminary surveys for a new storage reservoir in the towns of Southborough and Marlborough are reported as in progress.

FRANKLIN, MASS.—The purchase of the company's works by the town is being discussed.

MARBLEHEAD, MASS.—At a special meeting the town voted to ask authority to issue $50,000 additional water bonds.

METHUEN, MASS.—Application will be made by Chas. A. Tenny and others for authority to form a water company here.

ELLINGTON, CONN.—There is talk of reorganizing the Ellington Aqueduct Co., increasing the capital stock by $5,000, and substituting a 4-in. for a 2 in. main. The supply is from a brook.

Middle.

ALBANY, N. Y.—The council has voted, 11 to 4, against the proposed supply from the Normanskill. This leaves the question of an additional supply, to all appearances, where it was a year or more ago, or else points to the drawing of more and more water from the Hudson River, with or without filtration.

BABYLON, N. Y.—The building of works is again under discussion by home capitalists. The plan meeting with general public favor is to supply the villages of Babylon, Lindenhurst and Amityville with one plant, the works to be built at Lindenhurst, which is about centrally located within the territory to be included.

BALLSTON, SPA, N. Y.—Engr. J. S. Mott, Saratoga Springs, will soon report upon surveys in connection with a proposed increased or new supply.

ILION, N. Y.—C. W. Knight, of the Stanwix Engineering Co., Rome, N. Y., has been appointed Chf. Engr. to Water Comrs., and will prepare plans and superintend the construction of works.

MEDINA, N. Y.—Bauer, Bruff & Ross, of Rochester, have just received a franchise for works. There will be 90 hydrants at $40 each per year, and $35 each for additional. The supply will be from wells, it is reported.

LOCKPORT, N. Y.—The council has voted to send a bill to the legislature, the passage of which would enable the city to contract with the Lockport Water & Electric Supply Co. for water delivered to the city through the proposed hydraulic canal from the Niagara River at Tonawanda. The contract price is $50,000 for the supply for the first 10 years, with the privilege of renewal at the same rate until the contract has run 25 or 50 years, the price to advance at the rate of $1,000 per 1,000 increase in population above 30,000. The city may bond itself for half the amount and raise the remainder by taxation. John E. Pound was at the head of the special mayor's committee which reported the bill to the council.

NEWBURG, N. Y.—Contracts for improvements have been let as noted under "Contracting."

STONY POINT, N. Y.—According to report works are projected.

TROY, N. Y.—A 24-in. main about 1,800 ft. long is to be laid, and prices of pipe are wanted. A survey for a new reservoir on Piscawenkill Creek will be made by P. H. Baerman, Troy.

CRAMER'S HILL, STOCKTON TOWNSHIP, N. J.—Plans and specifications for the Stockton Township W. Wks. Co., are ready, and bids are wanted, according to the Camden "Post."

HOBOKEN, N. J.—It is reported that the Hackensack Water Co. has bought land in West Hoboken for a new reservoir.

CATASAUQUA, PA.—On Feb. 16 the people will vote on issuing bonds for borough works. The present supply is furnished by the Crane Iron Co.

HANOVER, PA.—G. Milton Bair has introduced a resolution to the effect that the popular vote be taken at the spring election on the issuance of $75,000 of 3½ 20-year bonds for water-works and electric lighting plants. The present supply is furnished by the Hanover Water Co.

LYKENS, PA.—The Williams Valley Water Co. has been incorporated to supply this place; capital stock, $40,000, of which $8,000 is paid in. Treas., H. G. Williams. The town is now supplied by the Lykens Water Co.

PHILADELPHIA, PA.—It was reported that on the 28th inst. Councilman Meehan was to introduce a resolution in Councils asking the Director of Public Works to report on the advisability of placing meters on all domestic consumers.

PHILLIPSBURG (BEAVER CO.), PA.—The borough is considering the building of works. W. S. Watson has reported to a citizens' meeting on a supply of water from Elkhorn Run or the Ohio River. The Ohio River plan includes pumping station, filter and reservoir at an estimated cost of $35,000. The Borough Council has taken steps in the matter.

TROY, PA.—On Feb. 16 the people will vote on issuing $25,000 of bonds for works. There are two small plants now owned by private parties.

MIDDLETOWN, MD.—A committee to report on the building of works and to prepare a bill authorizing the town to issue bonds to pay for the same has been appointed by the taxpayers. C. A. Heagy Burgess, C. E. Niemeyer and others are on the committee.

Southern.

GRAFTON, W. VA.—T. M. Jackson, Clarksburg, has made a proposition to build private works. The council has voted to refer the matter to the people at the March election.

PLAQUEMINE, LA.—The Plaquemine W.-Wks. Co. has been incorporated; Sec., David Altemus; capital stock, $10,000.

DUCKTOWN, TENN.—The Burra Burra Co. has been incorporated under the laws of New Jersey to supply water or steam power; Warren Delano, Jr., East Orange, N. J.; Jas. G. Parks, Ducktown, and others; capital stock $100,000, of which $1,000 is paid in.

UNION CITY, TENN.—The water and electric lighting plants were put in operation Jan. 22.

HENDERSON, KY.—It is reported that a new reservoir will be built.

North Central.

COLUMBUS, O.—According to the "Post" about 15 miles of 20 to 6-in. mains will be laid this year if the legislature grants authority to issue bonds.

CRESTLINE, O.—On Jan. 30 the people will vote on the issuance of $50,000 of bonds for additional land for works and for improvements.

GLENDALE, O.—The ordinance providing for an election to decide whether works should be built failed to pass the Village Council.

JEANETTE, O.—It is reported that works will be built.

LOGAN, O.—The Logan Telephone, Water & Light Supply Co. has been incorporated; capital stock, $25,500.

MARIETTA, O.—An extension of mains to the west side is under consideration.

MARION, O.—It is reported that authority to buy the works is being sought by the city.

NORWALK, O.—The special Water-Works Committee has recommended the adoption of the plans of Engr. C. A. Judson, Sandusky, for a new supply from Norwalk Creek. The plans include a storage reservoir, or reservoirs, with a capacity of 230 000 gallons; the moving of the present pumping plant, the addition of 2,250,000 to 3,000,000-gallon pump with boiler, a 250,000 gallon stand-pipe and seven or eight miles of mains. A special election may be held to vote on the above.

ADRIAN, MICH.—A proposition to bond the city for $135,000 for works is reported. The place is now supplied by a company.

CASAOPOLIS, MICH.—W. D. Hopkins informs us that contracts for works will be let by the village on Feb. 10. The supply will be pumped from Stone Lake directly to the mains. One pump and boilers are now owned by a private party. Another pump will be bought and pipe laid at an estimated cost of $10,000.

NILES, MICH.—The company's works have just been sold at auction by order of the court. The purchasers were the Michigan Trust Co., Grand Rapids, who bought the works as trustees for the bondholders. The works may be improved.

BYRON, ILL.—A citizens' committee has been appointed to present a plan for works.

NORMAL, ILL.—An address on the building of works has been made before the Improvement Association by Engr. G. C. Morgan, Chicago. Mr. Morgan offered to build a plant and lease it to the town with the option of purchase after five years. R. L. Fleming is Secretary of the above association.

STREATOR, ILL.—A petition is being circulated asking for the extension of the mains across the river to the part of the city known as Riverside.

MENASHA, WIS.—A proposition to supply the town from springs and an artesian well has been made.

NEENAH, WIS.—Engr. W. F. Goodhue, Milwaukee, has recommended that a supply be taken from Lake Winnebago through a filter gallery at an estimated cost of $55,000. The plan includes pumps, a stand-pipe, 12 miles of mains and 100 hydrants. The matter is in the hands of the Council.

Northwestern.

ALGONA, IA.—There is talk of extending the mains this spring.

KENYON, MINN.—According to report works will be built in the spring.

LINCOLN, NEB.—More extensive works are under discussion. The plant is owned by the city.

DEADWOOD, S. DAK.—Joseph B. Moore, as agent for Jeremiah Flannigan and Michael Donovan, has offered to sell the city the water flowing in Polo Creek and from two tributary springs for $35,000. A survey by Cy. Engr. P. L. Rogers shows that a flume could be built which would deliver water at a higher elevation than the tank of the company now supplying the city.

STURGIS, S. DAK.—The city has granted a franchise to a local company and work will be commenced at once according to report. The supply will be piped from Alkali Creek three miles distant to two reservoirs.

Southwestern.

COLUMBIA, MO.—The location of the new State University buildings here is said to be conditioned, at least in part, to the introduction of water-works. The university buildings were recently burned.

HANNIBAL, MO.—Plans and specifications for the company's proposed new reservoir are reported ready. It is said that bids will be received until the latter part of February. The reservoir will have a capacity of 16,000,000 gallons. It will be in two compartments, each of which will have a tower and three inlet valves at different levels. About 50,000 cu. yds will have to be moved. Estimated cost of reservoir, $50,000.

CREEDE, COLO.—W. H. Hurd, Denver, has located water rights in East and West Willow Gulches, for Denver parties, who propose to build water and electric plants. A second company is said to be in the field.

VAN BUREN, ARK.—Works are projected.

DALLAS, TEX.—Bids are wanted at the office of Cy. Secy. W. McGrain, until 6 p. m., Feb. 3, for a 10,000,000-gal. lon low duty vertical and a 6,000,000-gallon high service horizontal pumping engine, each in place at the Turtle Creek station, including foundations, valves and connections.

DENTON, TEX.—The new well is being tested, and if a daily supply of 100,000 gallons is developed contracts will be let by the city for water and electric lighting plants.

FORTH WORTH, TEX.—The $750,000 of water bonds authorized some time ago have been sold. The proceeds will be used to pay for work already contracted for with McArthur Bros., Chicago.

PALESTINE, TEX.—The lands and works of the Palestine Water Co. will be sold at St. Louis, Mo., Feb. 11, to satisfy a mortgage deed executed to W. Nichols, Trustee, of St. Louis.

VELASCO, TEX.—A flowing 8-in. well has been secured at a depth of 1,100 ft.

ELRENO, OKLA. T.—The Columbian Investment & Improvement Co., Topeka, Kan., through Secy. Simon Greenspan, has applied for a water, gas and electric lighting franchise.

Pacific.

LOS ANGELES, CAL.—The Special Council Water Committee has reported in favor of works to be owned by the city. It is proposed to conduct water from the river to a 365,000,000-gallon reservoir at an estimated cost of $200,000. This estimate does not include a distributing system, as it is possible to connect with the street mains of the three companies now supplying the city, provided the latter could be bought.

BRIGHAM CITY, UTAH.—According to the "Bugler both the council and citizens have voted for works to be owned by the village. Estimated cost, $20,000.

ARTESIAN WELLS.

FAIRBURY, ILL.—The Town Board has contracted with Chicago parties for a well; price, $4,500, if water is secured.

DALLAS, TEX.—A. Kenney, Dallas, has proposed to enter into a contract to develop 5,000,000 gallons of water daily from artesian wells.

MEMPHIS, TEX.—A well is wanted.

WAXAHACHIE, TEX.—H. G. Pickett, Mayor, wishes bids for sinking a well 1,000 ft.

IRRIGATION.

JULESBURG, COLO.—A survey has been completed for the Red Line and Julesburg Canal.

KIONA, WASH.—King, Dickinson & Huson, railway contractors, Tacoma, have received a contract to build 10 miles of ditch near this point; price, $100,000. Water will be taken from the Yakima River.

TOUCHET, WASH.—A survey is being made for Tacoma parties for a ditch to divert water from the Walla Walla River, beginning at about Whatman station. J. F. Boyer is interested.

MERCED, CAL.—Supt. F. C. Martin, of the Sharon estate, says a reservoir will be built in the mountains at the head of the Chowchilla River.

NEW COMPANIES.—Buffalo Rapid Ditch Co., Miles City, Mont.; Martin and Barney Colleran and Samuel Stone, $7,500. Clay Creek Ditch Co., Lamar, Colo.; Marion, Wm. I. and Wm. I. Craddock, Jr., $5,000. Sunnyside Park Ditch Co., Denver and Salida, Colo.; E. B. Jones and J. S. Israel, Chaffee Co.; H. J. Aldrich Arapahoe Co., $15,000; to buy and extend a ditch in Chaffee Co.

SEWERS.

ELMWOOD, MASS.—An engineer has been instructed to prepare plans for a sewerage system.

REVERE, MASS.—The sewerage committee has received from the State Board of Health a formal indorsement of their plan for sewerage and sewage disposal. The system accepted was recommended by H. T. Whitman, of Quincy, and is substantially as follows: The disposal of practically all of the sewage of Beachmont and Crescent Beach sections into the ocean, beyond the Ocean pier by gravity; the section north of Ocean Ave. and Revere St. into Pines river; the old part of the town, or Revere Centre, to be drained into Sales creek. It is expected that the system will now be built without unnecessary delay.

BROOKLYN, N. Y.—Proposals will be received until Feb. 4 for constructing sewers in District No. 24. Address John P. Adams, Comr. City Wks.

HORNELLSVILLE, N. Y.—A special election will be held Feb. 9 to vote on the proposed system of sewers.

MECHANICSVILLE, N. Y.—The State Board of Health has disapproved of the plans for the new sewers which are to discharge into the Hudson River.

PORT JERVIS, N. Y.—The town will raise $35,000 to complete the sewer system in course of construction.

SANDY HILL, N. Y.—Engineer Baerman, of Troy, is preparing surveys and maps for a sewer system. The question will be submitted to the taxpayers of the village at the spring election.

TROY, N. Y.—Nearly 15 miles of new streets are to be opened and sewers will doubtless be constructed in the same. Engineer Ricketts recommends vitrified pipe for all sewers of 20 ins. or less and brick for those of greater diameter.

DUNMORE, Pa.—The Council will spend $10,000 on a sewer to be built this year.

PHILADELPHIA, PA.—Two ordinances appropriating $419,000 for sewers have been recommended.

ATLANTA, GA.—Ordinances aggregating $36,000 for brick and stone sewers, and $11,123 for vitrified pipe sewers have been passed.

COVINGTON, KY.—The City Engineer has been directed to make surveys of the proposed Willow Run sewer, with estimates of the probable cost and the best material to be used.

COLUMBUS, O.—The City Engineer has been instructed to prepare a plan for a sewage pumping station, together with estimate of the cost; also to make suggestions and recommendations as to the sewage farm.

MILWAUKEE, WIS.—The Board of Public Works is preparing a list of new sewers to be built this year. They estimate for the city divisions as follows: East Side, $32,000; West Side, $94,886; South Side, $57,000; Bay View, $6,972. The amount specially set aside for the Menomonee Valley sewer is $85,000.

ISHPEMING, MICH.—Mr. John J. Lelley, of Milwaukee, was the lowest bidder for constructing a pipe and brick sewer at the foot of Parmenter St., to the Monominee river. His bid was $10,015 and the highest was $12,385.

KANSAS CITY, MO.—The Board of Public Works proposes to unite four sewer districts and to construct a sewer in the joint district to cost $15,000. The sewer will be from 2½ to 7 ft. in diameter and will remove the danger of any accumulation of filth near the packing houses when the river is low.

ST. CHARLES, MO.—The City Council is considering a proposition from the Lewis Mercer Construction Co., of New York, for the construction of a system of sewers.

SAN RAFAEL, CAL.—Engineers G. H. Mendell and George Davidson, of San Francisco, have submitted their report. They find a gravity system impracticable, and recommend storage tanks and a pumping plant. The estimated cost is $25,000. A mass meeting was held Jan. 21 to discuss the subject.

VISALIA, CAL.—At the next city election the question of $25,000 of bonds for a main system of sewers will be voted upon.

SEATTLE, WASH.—City Engineer Gardner reports that $75,000 or more will be needed for the Lake Union tunnel, $140,000 more for the South End tunnel and another $100,000 for the small sewer system.

TACOMA, WASH.—City Engineer Morrison is drawing a plan for the drainage of the city.

STREETS.

NEW CASTLE, PA.—It is proposed to pave the principal streets at an estimated cost of about $250,000, of which the city will pay one-fifth. An ordinance is before the Council for bonding the city for $50,000 for this purpose.

PHILADELPHIA, PA.—Mayor Stuart's plans for utilizing the $30,000 in systematic paving have been embodied in an ordinance now before the committee. According to this Bond St. will be paved with asphalt upon a concrete foundation, and the blocks thus removed will be used to improve 15 other streets, while the cobble stones from the other streets will be broken up and used for the concrete foundation of Bond St.

ATLANTA, GA.—Ordinances for paving aggregating $70,700 have been adopted. The Council has set aside $150,000 for street paving this year

MASSILLON, O.—The City Council has voted to pave South Erie St. with brick.

TOLEDO, O.—Proposals will be received until Feb. 15 for paving one street with cedar blocks, vitrified fire brick or Medina stone, together with the necessary grading, curbing, gutters, crosswalks, drainage, etc. Address C. H. Durian, City Clerk.

RICHMOND, IND.—Main St. is to be paved with vitrified brick. The proposed work is said to be the most expensive yet undertaken by the city.

CHIPPEWA FALLS, WIS.—Mr. David Kirk, Cy. Engr., writes us that the contract for 15,300 sq. yds. of cedar block paving has been awarded to Jas. E. Snyder, of Minneapolis, at $19,400. This price includes grading and curbing. There will be about 6,000 lin. ft. of curbing, and Berea sandstone will be used.

TACOMA, WASH.—The City Council has voted to open and improve 10 streets.

ELECTRICAL.

MALDEN, MASS.—A joint committee has been appointed to consider the feasibility of constructing a municipal lighting plant. Aldermen Eaton, Walker and Freeman are members of the committee.

NEWARK, N. J.—The Newark Electric Light & Power Co offers to light the whole city with 1,500 arc lamps of 2,000 c. p., to burn 4,000 hours a year, at 35 cts. each per night for 2 years, 32 cts. for 4 years, 28 cts. for 5 years.

BERKLEY, VA.—The Berkley & South Norfolk Water & Electric Co. has been incorporated and will establish an electric light plant. Information can be obtained from P. L. Poindexter, Norfolk.

RICHMOND, VA.—The Richmond Railway & Electric Co. has been awarded the contract for lighting the city until Feb. 8, 1894. The company will furnish 500 lamps of 2,000-c. p., at 27 cts. each per night.

BRIDGEPORT, TENN.—It is stated that the Bridgeport Lumber Co. will establish an electric light plant to supply its mills and the city.

LAFAYETTE, IND.—A contract has been awarded to the Brush Electric Light Co. for lighting the streets for 5 years, at $75 per lamp per year.

BUNKER HILL, ILL.—The City Council has voted to use electric street lighting. The incandescent light is proposed.

OMRO, WIS.—The city is being canvassed for electric light subscribers. If 200 lights are taken a plant will be established.

ROCKPORT, MO.—The city has voted $6,000 for putting in a system of electric lights.

ST. CHARLES, MO.—A special election will be held March 1 to vote on the question of incurring a bonded indebtedness of $10,000 to enable the city to put in an incandescent electric light plant.

LEMOORE, CAL.—Mr. Edward Erlanger contemplates putting in an electric light plant.

NEVADA CITY, CAL.—The city has awarded a contract to K. Casper to light the streets for one year, the Heisler incandescent system to be used.

ANACORTES, WASH.—Mr. Ira C. Otis, City Engineer, writes us as follows: "The Skaget Mill Co., composed of Harrison Clothier, E. G. English and James F. McCann, who were granted an electric light franchise in September, 1891, have incorporated as the Anacortes Electric Light Co. The lights were lit Dec. 30, and there are now 50 arc lights of 2,000 c. p. and about 200 incandescent lights. Of the arc lights 31 are street lights paid for by the city. The plant consists of one 125 HP. Woodbury engine, steam supplied from boilers in saw mill; one 50-arc light dynamo, and one 650-light alternating incandescent dynamo, both of Thomson-Houston make. Mr. W. L. Wright, electrical engineer, who superintended the erection of the plant, is putting in two 1,300-light dynamos at Seattle, Wash., an incandescent and arc plant for the Washington Mill Co. at Hadlock, Wash., and a 500-light plant for the Hotel Fairhaven, at Fairhaven, Wash."

NEW COMPANIES.—Westmoreland Electric Co., Greensburg, Pa.; Treasurer, W. S. Lane; $50,000. Pen Argyl Electric Light Co., Pen Argyl, Pa.; Treasurer, A. E. Young; $10,000. Somerset Electric Light Co. Somerset, Pa.; Treasurer, Valentine Hay; $12,000. Clinton County Electric Light, Heat & Power Co., Lock Haven, Pa.; Treasurer, J. A. Shaffer; $25,000. Home Lighting & Fuel Co., Parkersburg, W. Va.; Treasurer, B. D. Spillman; $250,000. Maryland Electric Light & Power Co., Baltimore, Md.; W. J. Dickey, S. J. Van Lill and W. H. Harken; $50,000.

CONTRACT PRICES.

WATER-WORKS.—Newburgh, N. Y.—The Board of Water Commissioners has awarded the contracts for building the open conduit from Silver Stream to Washington Lake, and for removing the muck from the latter, to the lowest bidders as follows: For building the conduit, O'Hehir & Fagan, Hackettstown, N. J.; earth excavation, 24 cts. per cu. yd.; rock, $1.05; paving, 9-in., 65 cts. per sq. yd.; paving, 12-in., 80 cts.; laid in mortar, $1 per sq. yd.; concrete, $6 per cu. yd.; sheet piling, 16 cts. per sq. ft.; plank grillage, $60 per M.B.M. According to the engineer's estimates the contract amounts to $16,140. The contract for removing muck was awarded to John K. Brown & Co., Montgomery, N. Y., at 27½ cts. per. cu. yd.

Atlanta, Ga.—The Board of Water Commissioners has awarded the contract for the excavation of the reservoir to S. B. Moseby & Co., of Bedford City, Va., who bid as follows: puddle excavation, 47½ cts. per cu. yd.; embankment, 15.99; waste, 12.99; solid rock, 60 cts. The contract amounts to $52,348.

Minneapolis, Minn.—The Water Commissioners have awarded contracts for supplies as follows: R. D. Wood & Co., hydrants, $36 each; Mohawk & Hudson Mfg. Co., Waterford, N. Y., valves, 6-in., $12.75; 8-in., $18.50; 12-in., $34.75; 16-in., $66.50; 24-in., $180. Minneapolis Foundry Co., special castings, $47.25 per ton; Dennis Long & Co., Louisville, Ky., pipe, $22.47 per ton. The last contract is for 2,500 tons, divided as follows: 6-in., 75,756 ft.; 8-in., 19,104 ft.; 12-in., 6,744 ft.; 16-in., 4,908 ft.; 24-in., 3,324 ft. All goods to be delivered f. o. b. cars in Minneapolis.

SUPPLIES.—Louisville, Ky.—City contracts for 6 months have been awarded as follows: Taurman & Powell, cast iron, .0165 ct. per lb.; wrought iron, .037 ct. per lb.; patterns, .045 ct. per lb.; J. R. Gleason, broken stone, $1.10 and $1.25 per cu. yd., also broken stone screenings, 95 cts. and $1 per cu. yd.; Ohio River Land Co., gravel, 70 cts. per cu. yd.; C. Nist, brick, for sidewalks, $8 per M., for cisterns, $6.50, for sewer repairs, etc., $7; Louisville Steam Roller Co., furnishing steam roller, 5 cts. per sq. yd.; Utica Lime Co., cement, 65 cts. per bbl.; lime, 73 cts.

STREET WORK.—New Orleans, La.—The lowest bid for each street, opened by the Committee on Finance Jan. 18, is as follows: Bartlett Chattawa Gravel Co., concrete gravel, $1.35 per sq. yd.; A. Rosenfeld & Co., Schillinger pavement, $1.37½ per sq. yd.; Rosetta Gravel Co., concrete gravel. $1.50 per sq. yd.; Julian Bartlett, Bartlett Chattawa gravel, $1.25 per sq. yd.

Los Angeles, Cal.—The lowest bids opened by the City Council Jan. 18 were as follows: Improvements of Fifth St.: J. H. Drain, curb, 40 cts.; paving, 27¾ cts.; sewer complete, 95¾ cts.; manholes, $55 each; flush tanks, $90. Temple St. sewer: Frick Bros., $1.05 per lin. ft. Grading of Ficket St.: Frank Chinoweth, $1.98 per lin. ft. Burlington Ave., grading, etc.: M. McGreel, $7.84 per lin. ft.; total, $19,600. Improvements on Bartlett St.: D. F. Donegan, grading, $3 per lin. ft.; curbing, 45 cts. per lin. ft.; cement sidewalk, 16 cts. per sq. ft.

Bay City, Mich.—P. Ryan & Co. will pave Sherman St. with vitrified brick at 77¼ cts. per yd.

Wooster, O.—Herring & Straub have the contract for paving South Market St. with vitrified brick at $1.25 per cu. yd.

MISCELLANEOUS.

PUBLIC BUILDINGS.—Washington, D. C.—The following bills for the erection of public buildings, with the amounts appropriated in each case, have been favorably reported: Omaha, $2,000,000; Helena, Mont., $200,000; Ogden, Utah, $250,000; Grand Haven, Mich., $50,000; Deadwood City, S. Dak., $200,000; Stillwater, Minn., $100,000; Dover, N. H., $100,000; Salem, Ore., $100,000; The Dalles, Ore., $100,000; Providence, R. I., $300,000; Fresno, Cal., $75,000; Tampa, Fla., $140,000; Waterbury, Conn., $100,000; Hastings, Neb., $250,000; Mansfield, O., $100,000; Norfolk, Neb., $250,000; Jacksonville, Ill., $75,000; Fergus Falls, Minn., $100,000; Nashua, N. H., $100,000; Zanesville, O., $100,000; enlarging the Marine Hospital at Detroit, $20,000; Post office at Mammoth Hot Springs, Yellowstone National Park, $10,000.

DAM.—Yorkshire Centre, N. Y.—Cattaraugus Creek has been surveyed with a view of building a stone dam to cost $15 000. Should a dam be built it will generate 1,000 HP., and will be a great incentive for manufacturers.

DREDGING.—Bids will be received until Feb. 25 for dredging Port Jefferson Inlet, New York. For information address D. C. Houston, Col. of Engrs., Army Bldg., 39 Whitehall St., New York.

OIL HOUSES.—Bids are asked until Feb. 9 for furnishing the material and labor necessary for constructing oil houses at Sanibel Island, Fla.; Gasparilla Island, Fla.; Egmont Key, Fla.; Pensacola, Fla.; Sand Island, Ala.; Battery Gladden, Ala.; Ship Island, Miss.; Head of Passes, La.; Sabine Pass, La., and Bolivar Point, Tex., light stations. Information may be obtained on application to Maj. James B. Quinn, Engr. Seventh and Eighth Lighthouse Districts, New Orleans, La.

BRICKS.—Montgomery, Ala.—The Street Committee has been authorized to advertise for bids for furnishing the city with 500,000 brick, to be delivered as needed.

GAS.—Newark, N. J.—The Newark Gas Co. offers to light, clean, put out and supply with gas for one year 2,100 gas lamps at $19 a lamp, each lamp to burn 4,000 hours in the year and to burn 4 cu. ft. of gas each hour. The company also agrees to supply gas to all the public buildings at the rate of $1.25 a thousand feet. The offer of the Citizens' Gaslight Co. is the same, except that the number of lights is placed at 1,134, the number it is now supplying.

STREET SPRINKLING.—St. Louis, Mo.—The Board of Public Improvements desires bids until Feb. 8 for 44 street sprinkling contracts.

FOG SIGNAL HOUSE.—Tompkinsville, N. Y.—Maj. D. P. Heap, U. S. Lighthouse Engr., has opened the following bids for furnishing labor and material for fog signal house at Sandy Hook, N. Y.: D. V. Howell, New York, $3,093; Jno. Larkin, Clifton, N. Y., $1,580; Frank Rinschler, Stapleton, N. Y., $4,300; J. H. Hathaway & Co., Philadelphia, $3,485; W. Andrews & Sons, Tompkinsville, N. Y., $6,498; D. A. Pers, Pt. Richmond, N. Y., $4,000.

HOSE.—Brooklyn, N. Y.—The following proposals for furnishing 15,000 ft. of fire hose have been received by the Fire Department: For 9,000 ft. 2½-in. cotton hose, Eureka Hose Co., 94 cts. per ft.; for 6,000 ft. 2½-in. rubber hose, Gutta Percha Rubber Mfg. Co., 94 cts. per ft.

BONDS.—Portland, Ore.—The Port of Portland is issuing $100,000 of bonds for harbor and river improvements.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Rogers Locomotive Works, of Paterson, N. J., have built a switch engine weighing 50 tons for the Columbus, Shawnee & Hocking. The Baldwin Locomotive Works, of Philadelphia, Pa., have orders for 15 passenger and 35 freight engines for the Baltimore & Ohio, a four-cylinder compound for the East Tennessee, Virginia & Georgia, and 15 four-cylinder compound suburban engines with Wooten fireboxes for the Philadelphia & Reading. They have built a four-cylinder compound twelve-wheel engine for the New York, Lake Erie & Western. The Illinois Central will add a number of switch and suburban engines to its equipment, the latter being for the World's Fair traffic. The Burlington & Missouri River has ordered 20 engines for the Black Hills Division.

CARS.—The Mount Vernon Car Co., of Mount Vernon, O., is building 200 coal cars and 100 refrigerator cars for the Mobile & Ohio. The Columbian Palace Car Co., of Chicago, Ill., has been incorporated by A. C. Story, A. C. Brackenbush and Geo. F. Westover; capital stock, $6,000,000. The Central R. R. of New Jersey has placed contracts for 1,000 gondola coal cars and 250 box cars of 50,000 lbs. capacity; all will be fitted with automatic couplers, and the latter will have air brakes. The Texas & Louisiana Equipment Co., of Chicago, Ill., has been incorporated by M. L. Willard, Lockwood Honore and E. H. Dupee, with a capital stock of $100,000.

THE GROTON BRIDGE & MFG. CO., of Groton, N. Y., has the contract for a bridge of 155-ft. span, 20-ft. roadway and two 5-ft. walks for the New Street Bridge Co. at Bethlehem, Pa. The company has also important contracts at Point Pleasant, W. Va., and Jacksboro, Tenn. and a large span for the Risdon Iron Works, of San Francisco, Cal.

MACHINERY.—Mr. Chas. H. Parker, M. E., formerly superintendent of the machinery department of Edward Kendall & Sons, Cambridgeport, Mass., with Mr. W. W. Field, foreman, and Mr. Chas. P. Mitchell, of Boston, have formed a partnership and purchased the tools, patterns, records and good will of the machinery department, and will continue the manufacture of hoisting and mining engines and general machinery, under the firm name of Parker, Field & Mitchell.

COMPANIES.—Kinsman Block System Co., Plainfield, N. J.; $2,000,000; F. E. Kinsman and E. C. Perkins, of Plainfield, and G. Colby, of Orange. Patton Vitrified Brick Co., Chicago, Ill.; $50,000; E. H. Dupee, George C. Patton and H. N. Wolf. American Aluminum Co., Denver, Colo.; $2,000,000; Henry Harper, Robert Weknight and J. A. Proud, all of Philadelphia, Pa. Seneca Construction Co., Jersey City, N. J.; $500,000; G. W. Littell, of Cranford; F. Manners, of Newark, and W. P. Toler, of Elizabeth. Detroit Brake Beam Co., Detroit, Mich.; $150,000; F. H. Seyman and T. H. Simpson. Boston Filter Co., Portland, Me.; $100,000; Pres., Geo. D. Emery, Cambridge, Mass. United Incandescent Gas Light & Fuel Co., Chicago, Ill.; $500,000; Jacob N. Goldsmith, E. T. Williams and C. F. Smallwood. Automatic Car Coupler & Fastener Co., New York; $2,500,000; B. D. Traitel, E. H. Sentenne and A. Birchman. Holly Steam Heat & Power Co., Chicago, Ill.; $500,000; James P. Oellers, T. H. Martin and T. Dorwin. Smokeless Fuel Co., Chicago, Ill.; to manufacture gas; $2,000,000; Herbert A. Brown, S. D. Maddin and L. F. Dancey. Lacasto Patent Hand Car & Velocipede Co., Austin, Tex.; $50,000; O. A. Marshall, J. M. Harper and B. C. Epperson, all of Jefferson, Tex.

CURRENT PRICE LIST.

RAILS.—New York: $30; old rails, $21 to $21.25 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $22.75 to $23 for iron and $17 to $17.50 for steel. Chicago: $32; old rails, $22.25 for iron and $14.50 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.7 to 1.75 cts.; spikes, 2.1 to 2.2 cts.; track bolts, 2.65 to 2.9 cts., with square and hexagonal nuts. Pittsburg: splice bars, 1.7 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 to 2.2 cts.; iron track bolts, 2.65 cts. with square and 2.75 cts. with hexagon nuts. Chicago: splice bars, 1.8 cts. for iron and steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.65 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½% on black and galvanized butt-welded; 67½ and 55% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $17.50. Pittsburg: $14 to 16. Chicago; $14.25 to $16.

LEAD.—New York: 4.2 cts. Chicago: 4.05 cts. St. Louis: 3.95 cts.

STRUCTURAL MATERIAL.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.9 to 2.1 cts. for tank, 2.15 to 2.3 cts. for shell, 2.4 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2 cts.; tees, 2.25 to 2.35 cts.; universal iron mill plates, 1.95 to 2 cts.; sheared steel bridge plates, 1.9 to 2 cts.; refined bars, 1.75 to 1.8 cts.; steel plates, 2 to 2.05 cts. for tank, 2.1 to 2.15 cts. for shell, 2.35 to 2.5 cts. for flange, 3.75 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.15 cts.; tees, 2.4 cts.; universal plates, 2.12½ cts.; sheared steel plates, 2.2 to 2.25 cts.; steel plates, 2.4 to 2.6 cts. for tank, 2.75 to 3.5 cts. for shell, 3 to 3.25 cts. for flange.